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POLLUTION OF LAKE ERIE AND ITS TRIBUTARIES - INDIANA, MICHIGAN, NEW YORK, OHIO, PENNSYLVANIA. PROCEEDINGS OF CONFERENCE, TECHNICAL SESSION HELD AT CLEVELAND, OHIO ON AUGUST 26, 1968

Federal Water Pollution Control Administration
Washington, D. C.

1968

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PROCEEDINGS

DETROIT
LAKE ERIE
BUFFALO
ERIE
CLEVELAND
FORT WAYNE

Technical Session
August 26, 1968
Cleveland, Ohio

CONFERENCE

Pollution of Lake Erie and its Tributaries-- Indiana, Michigan, New York, Ohio, Pennsylvania

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U.S. DEPARTMENT OF THE INTERIOR • FEDERAL WATER POLLUTION CONTROL ADMINISTRATION

CONFERENCE

In the Matter of Pollution of

Lake Erie and Its Tributaries

TECHNICAL SESSION
STATLER HILTON HOTEL
CLEVELAND, OHIO
AUGUST 26, 1968

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Technical Session in the matter of the pollution of Lake Erie and its tributaries, convened at 9:30 a.m., in the Garden Room of the Statler Hilton Hotel, Cleveland, Ohio, on Monday, August 26, 1968.

PRESIDING:

Murray Stein, Chief, Enforcement, Federal Water Pollution Control Administration, Washington, D. C.

CONFEREES:

Frank O. Bogedain, New York State Department of Health, Albany, New York

Lorin F. Oeming, Michigan Water Resources Commission, Lansing, Michigan

George H. Eagle, Ohio Department of Health, Columbus, Ohio

H. W. Poston, Regional Director, **Great Lakes Region, Federal Water Pollution Control Administration, Chicago, Illinois**

Blucher A. Poole, Indiana State Board of Health, Indianapolis, Indiana

Richard M. Boardman, Pennsylvania Department of Health, Harrisburg, Pennsylvania

- - -

PARTICIPANTS:

Dr. A. F. Bartsch, Pacific Northwest Laboratory, Federal Water Pollution Control Administration, Corvallia, Oregon

Sharon D. Bresler, Director of Utilities, Lima, Ohio

Frank Hall, Federal Water Pollution Control Administration, Great Lakes Region, Chicago, Illinois

George L. Harlow, Cleveland Program Office, Federal Water Pollution Control Administration, Cleveland, Ohio

John E. Richards, Ohio Department of Health, Columbus, Ohio

Dr. David G. Stephan, Acting Assistant **Commissioner for Research and Development,** Federal Water Pollution Control Administration, Washington, D.C.

John J. Wirts, Easterly Pollution Control Center, Cleveland, Ohio

John Weaver, Proctor and Gamble, Cincinnati, Ohio

- - -

ATTENDANTS:

E. Thomas Alvord, Rand Development Corporation, Cleveland, Ohio

Dr. Daniel G. Bardarik, Pennsylvania Department of Health, Harrisburg, Pennsylvania

Ed Barth, Federal Water Pollution Control Administration, Cincinnati, Ohio

Robert C. Black, Soap and Detergent Association, New York City, New York

Tom Braidech, Federal Water Pollution Control Administration, Cleveland, Ohio

Richard W. Brown, Hammermill Paper Company, Erie, Pennsylvania

Thomas M. Burnett, Cleveland, Ohio

D. S. Caverly, Ontario Water Resources Commission, Toronto, Canada

Thomas Colpetzer, Lake County Health Department, Painesville, Ohio

Thomas W. Cooper, Municipal STP Manager, Columbus, Ohio

Seba H. Estill, Izaak Walton League, Cleveland, Ohio.

Carlos Fetterolf, Michigan Water Resources Commission, Lansing, Michigan

David L. Flynn, Stanley Consultants, Cleveland, Ohio

ATTENDANTS (Continued)

Joseph B. Gaghen, Dow Chemical Company, Cleveland, Ohio

George B. Garrett, Ohio Department of Health, Columbus, Ohio

G. A. Hall, Ohio Water Pollution Control Board, Columbus, Ohio

Richard D. Hall, Diamond Shamrock Corporation, Cleveland, Ohio

Robert P. Hartley, Federal Water Pollution Control Administration, Cleveland Program Office, Cleveland, Ohio

James Haube, City of Toledo, Toledo, Ohio

Henry Hauenstein, Finkbeiner, Pettis and Strout, Toledo, Ohio

Ihor Havryluk, A. C. Ackenheil and Associates, Pittsburgh, Pennsylvania

Clifford R. Hindman, Burgess and Niple, Limited, Mentor, Ohio

Robert Howick, Reporter, WKBF-TV 61, Cleveland, Ohio

Bob Kasarda, News Photographer, Cleveland, Ohio

ATTENDANTS (Continued)

Betty Klaric, Reporter, Cleveland Pres,, Cleveland, Ohio

Donald G. Kirk, Hammermill Paper Company, Erie, Pennsylvania

Sanford Kwasney, City of Cleveland, Cleveland, Ohio

Robert K. Jordan, U. S. Steel Corporation, Pittsburgh, Pennsylvania

Perry Miller, Indiana State Board of Health, Indianapolis, Indiana

Peter T. Miller, Cinematographer, WJW-TV, Cleveland, Ohio

Hal Morgan, Reporter, WJW-TV-8, Cleveland, Ohio

Dr. Paul Olynyk, Cleveland State University, Cleveland, Ohio

Michael F. Pikus, Cleveland State University, Cleveland, Ohio

Chris Potos, Federal Water Pollution Control Administration, Cleveland, Ohio

Glenn Pratt, Federal Water Pollution Control Administration, Chicago Regional Office, Chicago, Illinois

ATTENDANTS (Continued)

Tad Rajda, Federal Water Pollution Control Administration, Washington, D.C.

Lawrence E. Rigby, F. G. Browne and Associates, Marion, Ohio

Ray Roth, City of Cleveland, Bureau of Industrial **Wastes**, Cleveland, Ohio

Agnes **Rupp**, Federal Water Pollution Control Administration, Cleveland, Ohio

James P. Schaefer, City of Cleveland, Bureau of Industrial Wastes, Cleveland, Ohio

Robert Seid, Reporter, WEWS News, Cleveland, Ohio

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R. N. Simonsen, Standard Oil Company of Ohio, Cleveland, Ohio

Robert C. Singer, "Water in the News," New York City, New York

Alfred Smith, Federal Water Pollution Control Administration, Cleveland, Ohio

ATTENDANTS (Continued)

Mrs. Richard L. Smith, League of Women Voters, Fairview Park, Ohio

Standly H. Sutton, Havens and Emerson, Cleveland, Ohio

Martha Takacs, Cleveland State University, Cleveland, Ohio

W. R. Taylor, Diamond Shamrock Corporation, Cleveland, Ohio

William A. Telliod, City of Cleveland, Water Division, Cleveland, Ohio

Larry J. Vereb, Cleveland State University, Cleveland, Ohio

Fred A. Voege, Ontario Water Resources Commission, Toronto, Ontario, Canada

Adel Wagner, Federal Water Pollution Control Administration, Cleveland, Ohio

G. H. Watkins, Lake Erie Watershed Conservation Foundation, Cleveland, Ohio

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PROCEEDINGS

OPENING STATEMENT

BY

MR. MURRAY STEIN

MR. STEIN: May we come to order, please? The meeting is open.

This is a Technical Session growing out of the Federal-State Water Pollution Control Conference on Lake Erie.

The Conferees have unanimously come up with an analysis of the problem and a time schedule and requirements for cities and industries in the five States concerned.

We would like to address ourselves at this technical meeting to just the single problem of the nutrient impact on the aging and eutrophication of the lake and that is all -- I guess particular emphasis on the phosphate problem.

This -- and I would like to emphasize it again -- will be a technical meeting and if your notion of entertainment is listening to a technical meeting that is what you are going to have. We are not going to take up any other question or broad questions of policy.

The Federal Conferee is here, Mr. H. W. Poston.

Opening Statement - Mr. Stein

For Indiana, Mr. Blucher Poole; Perry Miller. From Ohio, Mr. George Eagle and Mr. Richards. From Pennsylvania, Mr. Richard Boardman and Dr. Bardarik. From New York, Mr. Frank Bogedain. From Michigan, Mr. Loring Oeming. And my name is Murray Stein and I am the representative of the Secretary of the Interior, Stewart Udall and from Washington, D.C.

We may have a lot of people participating in the meeting today. Our proposal would be to utilize the questions submitted by Mr. Eagle -- a list of about seventeen questions -- have the questions read, have one of our experts try to give an answer to the questions and then have any comment or clarification made by the Conferees or anyone -- technical expert or anyone else a Conferee may want to call on at that time.

I would suggest in view of the number of people who are going to participate in the meeting that if you are called on to make a comment or ask a question you identify yourself by your last name and the State.

Now, do any of the Conferees want to make a statement or make a comment before we start with the questions?

MR. POSTON: Mr. Chairman.

MR. STEIN: Yes.

MR. POSTON: Do I understand that the question will be read and the answer will then be read?

MR. STEIN: The answer or a summary. Any kind of answer you want to make to the question, if you can summarize it, this will be fine. I think the question and the full written answer which the Conferees have will appear as read in the transcript. We are making a transcript of this meeting which will be available and I think we probably will be able to have much useful technical information in that.

MR. OEMING: Do I understand that the answers to these questions were prepared by Dr. Stephan and Dr. Bartsch jointly?

MR. STEIN: Dr. Stephan, Dr. Bartsch and our regional staff here. They were prepared as most answers are prepared, individually, and then they got together by conference call and discussed this, and I think these are pretty generally the position.

What we intend to do is have the question read and then have the particular specialist from the Federal Government give the answer, and then you can make any comment or questions. If we have to call on another specialist at that time, we are prepared to do so and hope you are.

Again, we will limit the questioners and the comments to the people the Conferees call on and that is all. I hope they will all be confined to -- I don't want this limited necessarily to the seventeen questions, but I hope they will be germane to the technical purpose of the meeting.

MR. OEMING: My only comment here, Mr. Chairman, was that I am assuming, maybe wrongly so, that Dr. Stephan and Dr. Bartsch are the experts here and those are the ones I came down here to hear.

MR. STEIN: Yes, they are going to be available, but the point is: we did not frame the questions, and a good many of the questions are directed really at our regional people. The regional people have the material on hand rather than Dr. Bartsch or Dr. Stephan. Both of these men went over the questions very, very carefully.

To give you a notion of the procedure we use, both Dr. Bartsch and Dr. Stephan went over the questions. They had the first crack. The questions which they thought were appropriate for them to answer they answered. Certain questions they figured were not appropriate for either one and would be handled largely by Mr. George Harlow who has been doing work in the region. He will supply the answers to those questions.

MR. OEMING: There is no objection to a Conferee asking Dr. Bartsch or Dr. Stephan to comment.

MR. STEIN: Not at all, sir. That is right.

MR. POSTON: I had proposed that we have the question read and the answer, as provided here, and then the Conferees could ask any one of our experts here to elaborate or clarify anything they had in mind.

MR. STEIN: Well, I thought that is what we had outlined in the procedure to begin with. Let's go on with the first question and see how it works.

Mr. Hall, would you read the question, please? You know who is going to handle each answer, don't you?

MR. POSTON: Yes.

MR. STEIN: Question 1.

MR. HALL: Question No. 1: Will an 80 percent reduction of phosphates in all wastewater discharges in the Lake Erie basin eliminate algae in the western basin?

Mr. Stein, would you like me to read the answer?

MR. STEIN: You or anyone else can read the answer.

MR. POSTON: Well, Dr. Bartsch provided the answer on this question.

MR. STEIN: Why don't you handle that?

I would suggest the one who is the specialist provide the answer.

Dr. Bartsch.

DR. BARTSCH: If you need identification for your record, I am A. F. Bartsch.

The answer is as follows: No. Elimination of algae is neither feasible nor desirable. Algae are necessary as food for higher forms of life. They are now present in an abundance several orders of magnitude greater than necessary to sustain those higher forms. An 80 percent reduction of waste phosphate input will reduce the algae population to nearer a balance between that population and those of the higher forms. More importantly, it will be somewhat selective in that those algae which require greater amounts of phosphorus will experience greater reduction in population. It is these algae (mainly blue-green) which are the most troublesome in water supply and in their ability to produce massive "blooms."

In contrast to Lake Michigan, Lake Erie, at least in the western basin, already has reached a historical stage capable of producing planktonic algae in amounts considered to be excessive. Such production is an expression of the fertility of the water -- its chemical composition -- and a response to physical factors such as light energy, transparency and suitable temperature. In discussing nitrogen and phosphorus as algal nutrients in connection with considerations in Lake Michigan, I, FWPCA, stated, "In any event, the quantity of algae a lake can grow is largely determined by the amount of nutrients available. The more nutrients there are, the more algae there will be, the greater the nuisance will become. There is evidence that continued input of nutrients can finally bring a lake beyond the point of no return -- to the stage where continuous recycling of nutrients already present can result in production of nuisance growths of algae."

It should be recognized that there is no real magic number for nitrogen or phosphorus (other than zero) below which there will be no growth. If even greater algal production in the western basin is now curtailed because nutrient supplies are exhausted as growth approaches the peak of a bloom (as opposed, for example, to light extinction or some other physical cause), any actions that decrease nutrient availability will result in a smaller algal crop. If one can formulate a program that will bring soluble phosphorus to a level of 0.010 mg/l and inorganic nitrogen to a level of 0.3 mg/l before the growing season begins, the resulting crop of algae will be small, consistent with these levels and presumably tolerable.

Dr. R. Vollenweider, after reviewing for the

Organization for Economic Cooperation and Development all circumstantial data available on nutrients versus algal problems in lakes throughout the world, finds basis for belief that loading rates and recycling from sediments are more significant than concentrations existing at the moment. He concludes that critical loading rates in this sense are 0.2 to 0.5 g/m^2/year for phosphorus and about 5 gm/m^2/year for nitrogen. The influences of sediment-water interchange are superimposed on this.

Because no systems are perfect, and because nutrient input comes from many sources, some not measured and perhaps some not even known, it is believed that a remedical campaign should not be satisfied with aiming toward these specific numbers but should be designed to curtail nutrients in every possible way from every known source. It is not known if Lake Erie is now at the point where continuous recycling of nutrients already present can result in production of nuisance growths of algae, but there seems little question from our knowledge of Lake Erie conditions that the action must be remedial and not preventive. In any event, curtailment of nutrient input must be so designed that phosphorus concentrations available for algal growth are brought down to levels that will permit the total lake system to purge itself of existing abundant supplies.

It is quite possible, and perhaps probable that, in the western basin, even though the reduction in algae may be substantial, it still will not be to a desirable level with an 80 percent reduction of phosphate input. More than half of the phosphorus discharged to Lake Erie is to the western basin, including a large amount in runoff. An 80 percent reduction there still leaves a large amount entering the lake and this amount will surely increase in the future if positive steps are not taken to reduce phosphorus levels in waste effluents. Therefore, serious consideration should be given to greater than 80 percent reduction, since this is now feasible. Even then, algal production in the western basin will be greater than in the rest of the lake, but that is understandable because the western basin is also the most productive of fish and food requirements are greater.

MR. STEIN: Thank you, Dr. Bartsch.

Are there any comments or questions?

MR. OEMING: Dr. Bartsch, will you clear up something for me? When you are using the term 'phosphorus,' you are expressing it as 0.010. Is that as phosphorus or as PO_4?

DR. BARTSCH: No, that is as phosphorus.

MR. OEMING: So the level would be as PO_4, about .03, wouldn't it?

DR. BARTSCH: Yes.

MR. OEMING: Do you recall, Dr. Bartsch, what recommendations were made at the original Interstate Lake Erie Conference? Was it .03 as PO_4?

DR. BARTSCH: I am sorry, I cannot answer that. I do not know.

MR. OEMING: I think that is correct. I wondered if you knew that, or if you were proposing a different level here than had been recommended and accepted by the original Conferees to the Lake Erie Conference.

DR. BARTSCH: My impression is **that is the same level. MR. OEMING: It is the same. I would like this to be verified though by someone else here.**

MR. POSTON: Mr. Harlow can answer that.

MR. HARLOW: My name is George Harlow, Director of the Lake Erie Program Office of the Federal Water Pollution Control Administration.

This is the same level, Mr. Oeming, that was recommended by the Technical Committee. This is the level upon which they based their recommendation for phosphorus and nitrogen control.

I don't recall at the original meeting in 1965 the Conferees deciding upon a level at that time. They left it in abeyance and it depended upon the recommendation

Questions and Answers of the Technical Committee.

MR. OEMING: They had not decided on a level but the record is full of recommendations by the biologists of FWPCA and I think the figure was .03 and that is what I am trying to confirm as PO_4. Does this represent a change in the ground rules?

MR. HARLOW: **No. This is probably correct and it has always presented, I think, a confusing picture of this** phosphorous problem, how you talk about it. But to my knowledge, in every instance when we spoke of 0.03, we were talking as PO_4, and when we talk about 0.01, we are talking as P.

MR. STEIN: Any other comments or question on the first question?

Yes, Mr. Poole.

MR. POOLE: This is not a comment exactly, it is a question.

When we are talking about 0.01, are we talking about total phosphorus or soluble phosphorus?

DR. BARTSCH: These recommendations, as I understand them, have reference to soluble phosphorus and not total phosphorus.

MR. STEIN: Are we in agreement? Are there any other comments? Any other comments or questions? If not, we will try to get on with Question No. 2.

Questions and Answers

MR. HALL: Question No. 2: Is the natural level of phosphates in Lake Erie adequate to permit algal growths even if all phosphates are eliminated from municipal and industrial discharges?

MR. POSTON: George Harlow.

MR. HARLOW: The answer: Yes. Bureau of Commercial Fisheries' observations have noted algal growths in quiet coves of Lake Superior where natural phosphorus levels should be lower than the "natural level" in Lake Erie. Lake Erie can never reach a completely "natural" level now because of the impossibility of controlling entirely the runoff of artificially introduced phorphorus. However, it is suspected that something near the natural level now exists, at least for part of the year, in midlake, central, and eastern basin waters and these waters do sustain algal growth, though not at obnoxious levels.

Natural levels of phosphorus in Lake Erie prior to the impact of domestic and industrial waste discharges to the system are, in fact, not known. The influence of domestic and industrial wastes on the concentrations of calcium, chloride, sodium-plus-potassium and sulfate during the past 50 years in Lake Erie is well documented, however.

That completes the answer to the question.

Questions and Answers

MR. STEIN: Are there any comments or questions on this one?

Yes, Mr. Poole.

MR. POOLE: I am assuming, George, when you are saying "natural level," you are including in that what we get from soil runoff.

MR. HARLOW: This is true.

MR. EAGLE: Mr. Chairman.

MR. STEIN: Yes.

MR. EAGLE: Mr. Harlow, I think you need to clarify here: what is the relationship here now between phosphates and these other chemicals that you point out about calcium and chloride and sodium-plus-potassium, and so on?

MR. HARLOW: The second part of this question was answered by Dr. Bartsch, I believe.

If I may be permitted, I think they are inferring because of the increases in these other substances that one can imagine or think that you have had somewhat similar increases in phosphorus.

We have measurements well documented in the past of these other substances in Lake Erie. We do not have comparisons on phosphorus many years ago, and it is by inference that you would presume that phosphorus has also increased in Lake Erie.

MR. EAGLE: Isn't it true that some of these increases have not been very significant? What do your figures show?

MR. HARLOW: I don't know specifically each one. I can think of one that is, I think, very well documented that comes to mind, and I think it gives a pretty good idea of the general overall change of the chemicals in the lake, and that is total solids. Total solids has gone up from around -- I think these figures are correct -- somebody correct me if I am wrong -- from around 145 milligrams per liter around 1900 to almost 200 milligrams per liter now.

MR. EAGLE: Yes. I don't want to belabor the point, but I don't think this is a valid comparison because these total solids might be from industry, for example, which had no contribution of phosphates, so I don't quite see the comparison. I am not going to belabor the point further, but I don't believe it is a valid comparison.

MR. HARLOW: I think there is no question in my mind and in the people that I have talked to that we are getting substantially greater inputs of phosphorus than we used to, and it seems to me that it is axiomatic if you are going to get more in the lake you are going to have more in the lake.

MR. EAGLE: Yes. I don't think there is any argument about that. But just because we are getting more total solids, I don't want it to follow that this makes it true that we are getting more phosphates. It may have no relationship at all.

MR. STEIN: Dr. Stephan.

DR. STEPHAN: Dave Stephan, FWPCA, Washington.

I would just like to strengthen George's comment here that the reason this particular statement was added or included in here was simply to indicate there is documentation on available records as to the increases in various soluble components in the lakes. These are mentioned here: calcium, chloride, sodium, and so on.

Data do not exist historically on the concentrations of phosphorus or of soluble phosphates in the lake, but I think one can infer that some increases have occurred. That is all we are trying to say. There is some data indicating increases in soluble inorganic salts in the lake. Phosphates, I think one would infer very strongly, were also included.

One other point: The levels of phosphorus as compared to the levels of chloride, which cause problems in the lake, pollution problems in the lake are quite different.

We are talking in terms of hundredths or tenths of parts per million in terms of phosphorus, whereas we are speaking maybe in terms of tenths or in some cases scores of parts per million of other materials such as chlorides.

MR. **BOGEDAIN:** These increases of inorganic salts -- are they related to the algal problem? Are they also nutrients or material for algal growth?

DR. STEPHAN: No. This was not the intent of the inclusion of these in here, not to imply that at all.

MR. STEIN: Are there any other comments?

DR. BARTSCH: Mr. Chairman, I would like to comment on this question, too.

MR. STEIN: Yes.

DR. BARTSCH: The question was asked whether some of these other contributions to the total dissolved solids might or might not be involved as algal nutrients, and I would like to go back and tell you some fundamental biology for the moment and simply point out that there are many elements which make up the total nutrient requirement of plants and we ordinarily think of some ten **major** ones, and if you want to remember how to remember this, you simply think of this ditty that says, "C. Hopkins Cafe, Mighty Good. I know that some of the biologists here are familiar with what I have just said because this is a clue to the fact that we are talking about calcium as a requirement; we are talking about carbon as a requirement; iron, magnesium, nitrogen, phosphorus, and so on.

When you follow that ditty, why, then, you have the identity to those ten. Some of them you will recognize contribute to this total story of dissolved solids in the lake.

In addition, there is an array of other elements, many of them metals, and some getting over into the organic compounds such as vitamins which are required as micronutrients in exceedingly minute amounts.

So I think I did want to emphasize that so far as the total dissolved solids picture is concerned, if we have a buildup of them, one can anticipate that the supply of essentially all of these nutrients for algal growth are going to be there in increased amounts.

MR. STEIN: Mr. Richards.

MR. RICHARDS: Earl Richards from Ohio. I think -- one additional comment, Fritz. I think it has been reported in some of the European lakes that possibly some of these other elements are triggering mechanisms, right?

DR. BARTSCH: I think there is a question in this array of 17 that refers to triggering mechanisms, and I think maybe this is not a true usage of the word so far as the nutrients are concerned. I prefer to think of this in this sort of way, that the triggering mechanisms have to do with rotation of the earth, for one thing, which determines the seasons of the year, the length of day, the intensity of solar radiation. These in some complicated fashion are really the triggering mechanism that determines when you have a bloom of diatoms, when you have a bloom of blue-green algae, and what the sequence is in the annual succession.

Think of the nutrients not so much as triggering mechanisms but the governor on the system that determines how big the crop will be.

MR. OEMING: Mr. Chairman, I would like to ask Dr. Bartsch a question to clear this matter up for me.

It would have been much more clear in my mind if that second paragraph had been left off. Isn't the answer in your first paragraph here, and isn't this second paragraph extraneous material really?

The question was asked: Is the natural level sufficient to have growths of algae without municipal and industrial discharges? And the first paragraph answers the question. What is the purpose of the second? You got me lost.

DR. BARTSCH: I hate to disclaim responsibility for the second part of the answer. I am not sure that this was the intent or not. In fact, I had some doubts in my own mind as to what was really meant by the word "natural" and if one interpreted it as I did originally to mean what was the phosphorous level in Lake Erie before the white man came around -- if this was the meaning -- why, then, I would conclude that the phosphorous level in Lake Erie was very low perhaps, sufficient to grow some algae, but most likely not to a level which would be obnoxious or onerous to people.

MR. OEMING: That is the answer I wanted and that is all I want to know.

MR. STEIN: Okay. Thank you.

MR. POSTON: I submit, Mr. Chairman, that maybe the first sentence, the word "yes" would have answered it.

MR. STEIN: I think there is more to it than "yes." Yes, but in certain levels not to obnoxious levels and presumably -- it is always a pleasure to listen to Dr. Bartsch.

You know 20 years ago, Fritz came to me, before anyone ever heard of this, and he said, "Let's leave the Government and go into business and clean up the algae problem in the lakes," and I never thought it was a problem. I wish I had your prescience.

Are there any other comments?

Questions and Answers

MR. HALL: The third question: Who documents the blooms in Lake Erie? Is there a continuing record of blooms?

MR. POSTON: George Harlow.

MR. HARLOW: Answer: To our knowledge, no concerted continuous effort has been made for reporting algal blooms for Lake Erie as a whole. However, the following institutions are among those studying the lake, and all of them have had studies on algae:

FWPCA, Cleveland Program Office

FWPCA, Detroit Program Office

Canadian Centre for Inland Waters at Toronto and at Burlington

Ohio Division of Geological Survey, Sandusky

Western Reserve University, Department of Biology, Cleveland

Great Lakes Research Division, University of Michigan

Ontario Water Resources Commision, Rexdale

Central Michigan University, Department of Biology, Mt. Pleasant

U. S. Bureau of Commercial Fisheries, Ann Arbor

State University of New York, Department of Civil Engineering, Buffalo

Questions and Answers

Syracuse University, Department of Geology

State University College, Division of Physical Sciences - Geology, New Paltz, New York

State University of New York, Great Lakes Laboratory, Buffalo

While blooms are not routinely documented, it is also true that the term "blooms" has not been precisely defined. Lackey defines a "bloom" as more than 500 organisms per milliliter, but, because of the great diversity in size of organisms, a number-per-unit-volume parameter is not universally applicable. Nonetheless, with regard to "continuing records," Michalski (Canada) has a four-year record of abundance at north shore water intakes and Davis has a 30-plus year record at Cleveland. These records and the term "bloom" consider only planktonic forms, not Cladophora or other attached algae.

MR. STEIN: Thank you.

Are there any comments or questions?

MR. EAGLE: Yes, I would like to ask Mr. Harlow a question.

George, is FWPCA now carrying on any studies to correlate nutrient levels in the lake with blooms? Are you making any observations on a continuing basis now?

MR. HARLOW: These kind of observations have been made in the past, but I wouldn't say with just that thought in mind. I cannot answer this as to this, but I do know that there are studies going on elsewhere in FWPCA to correlate phosphorous levels with blooms. I don't think Lake Erie is the type of place to make that kind of investigation---it is too large. We need to do it on a smaller lake. To my knowledge, FWPCA is doing this and maybe the others would prefer to answer this.

MR. EAGLE: I don't quite agree with you, 'it is too large.' We have some areas with very prolific growths. There isn't any question about this. Don't you think you should be making some nutrient measurements in these areas on a continuing basis?

MR. HARLOW: We do take measurements in these areas and we correlate algal growths with levels of phosphorus. The Nutrient Committee was very explicit on this point that where we are getting the high levels of algae, this is where we find the high levels of phosphorus.

MR. EAGLE: Is this information available in a report form from your office?

MR. HARLOW: This is reported in the Nutrient Committee Report.

MR. EAGLE: In a technical committee report?

MR. HARLOW: Yes, the technical committee.

MR. POSTON: I would like to ask Dr. Bartsch to comment on this with regard to eutrophication studies.

DR. BARTSCH: I am not sure about all of the confines that Mr. Stein put on the roaming around in the subject matter, but if we have freedom to leave Lake Erie --

MR. STEIN: Surely.

DR. BARTSCH: -- I would like to go back to about 1942 or thereabouts when Claire Sawyer went down the beginning of the road that led to some of these critical numbers that we have heard, which incidentally, as many of you know, have been misinterpreted many times.

But with this beginning and, in fact, other observations made by many of the old-time limnologists that go back to the time of Jacob Verduin and the turn of the century, it was demonstrated which many people now acknowledge that in any lake where you start to increase the nutrient levels, you get a resulting and following increase in the production of plant material.

Dr. Sawyer, you may recall, examined fourteen, if I remember the number correctly, lakes in southeastern Wisconsin for this very purpose of ascertaining what relationship there is between the levels of nitrogen and phosphorus and the annual production of algae. More recently -- and this, incidentally, is the basis for the

0.01 figure for phosphorus and the 0.3 figure for nitrogen.

More recently, Dr. Vollenweider, whom I cited in the answer to the first question, has made this kind of scrutiny of available information on all of the lakes in the world, and while you recall that I said that he said or felt that the rate of input is perhaps more significant than the concentrations existing at the moment, he did find essentially the same basis, the same numerical relations that Dr. Sawyer found in the Wisconsin lakes some 20 or 25 years ago.

To tie the context of this together, let me say that I see nothing in Lake Erie to indicate that there should not be expected to be a response of the algae in increasing numbers as the nutrient levels increase.

MR. RICHARDS: I believe that Dr. Sawyer, as I have heard him state many times and many of the other experts that talked to the technical committee, said it was quite dangerous to try to extrapolate from one body of water to another as far as the phosphate level or nutrient level of any kind. In other words, they did not want to stick their neck out and make a specific figure for any particular water, Lake Erie being included; so I feel that it would be quite appropriate to accumulate as much information as we can with respect to the waters of Lake Erie and algal blooms.

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DR. BARTSCH: In response to your comment, which I think is well taken, I have absolutely no disagreement. I think what you say here with respect to eutrophication we all know with respect to a vague knowledge in the field of water pollution generally, but I think we also have to recognize some basic fundamental facts of biology -- and this is really an ecological problem -- that if we are serious about reclaiming Lake Erie, and once we reclaim it, keep it in a condition which it is usable, we have no choice except to take this knowledge, and to me this means we have to reduce the nutrient input to a level that eventually we are going to get the nutrients out of the lake. This means we have to have the input down to a level less than the rate of output into the lake.

MR. STEIN: I would like to make a comment because I think Mr. Richards raised an interesting philosophic point of view.

I, of course, agree with everything you said, but as I understand Dr. Bartsch, it is pretty generally known what the general trend is going to be. If you put more nutrients in the lake, according to what Dr. Bartsch said, you will have an algal growth.

Now, by the same token, we cannot protect unless we predict, unless we get data on each stream precisely what each sewage treatment plant or industrial treatment plant is going to do, before we put it in, unless we make a particular study.

The question, it seems to me, here is: Do we have enough knowledge to be able to apply a nutrient reduction program in Lake Erie without having that particular knowledge on precisely what is going to happen in a body of water, or are we going to have to wait until we get all that information? If we do that, do we exercise the same kind of precise control in your State programs before you ask anyone to put in an industrial waste plant, or a sewage treatment plant, because I think this can be applied to every waterway we get into.

Now, I think this kind of approach we have here is a significant one.

Mr. Oeming.

MR. OEMING: I wonder, Dr. Bartsch, if you have in your own mind a definition of what the term "bloom" means or how you define that area. We are dodging the issue here by reporting in the literature and everything, but we are depending a lot on you here and I would like to know if you have a definition.

DR. BARTSCH: Yes, I have a definition. I have a definition for the layman, and I think with respect to the layman, this is the only way the term should be used.

To the layman, by my definition, a "bloom" is any growth of algae which has reached such proportion that it becomes nuisance-forming or obnoxious.

Now, the scientist has attempted to define a "bloom," and every time he has tried to do this he gets into difficulty because there are too many exceptions. And if you are interested why there are exceptions, I will go into this; but I think if we can agree that a "bloom" of algae simply means that condition of algal production in a body of water that we don't like; then this is what we will agree a "bloom" is.

MR. STEIN: Are there any other comments?

MR. EAGLE: Yes, Mr. Chairman.

A member of my advisory committee, Mr. John Weaver, I believe has a question from Mr. Harlow if this is in order.

MR. STEIN: Yes, Mr. Weaver.

MR. WEAVER: I think that we would be interested in the history of what has happened during 1968 as far as algal blooms are concerned, George.

MR. HARLOW: In Lake Erie?

MR. WEAVER: Yes.

MR. HARLOW: Are you talking about season by season?

MR. WEAVER: I am talking 1968 from the growing season on. Now, what has happened this year?

MR. HARLOW: I can only report as to particular cases that have appeared since spring. I cannot really report on point by point in the lake on exactly how the algae have gone up and down day by day, month by month. I think you have to recognize that we are dealing with ten square miles of lake, and you get ups and downs in the algae counts all over. You cannot be everywhere at every time. But lately, I can say that we are getting the usual counts of blue-greens in the lake. We are having a tremendous "bloom" right now in the western basin. We have had "blooms" all along the south shore of the lake, to the extent that we are having some rather difficult taste and odor problems at water intakes.

We went out this year testing water quality in the lake emphasizing summer water quality. This was in response to a request by one of the Conferees that we dwell on the dissolved oxygen problem in the lake, and it was during that time when we traversed the lake about a month ago that we made some observations regarding the algae. I asked my people what levels of algae they visually saw compared to last year and they said visually they looked greater this year. You can use that any way you want, because the year before they may have been less, or next year they may be less, because there is such a great variation in levels of algae from year to year depending upon the kind of things that Dr. Bartsch spoke of.

I am not sure I can answer your question exactly the way you want it, but these are observations here and there of how the algae is doing this year.

MR. WEAVER: That is exactly what I was after. I think your answer is very responsive. The reason really for the question was: At least our Ad Hoc Committee has not been aware of these "blooms" and I think that was one of the reasons for the basic question of who documents the "blooms," and so forth, because we have not simply been aware.

MR. HARLOW: Algae counts are documented, I do know, every day at the Cleveland water intakes, and they have been doing this for 30 years.

MR. POSTON: George, you talked about ten square miles here. Does this mean --

MR. HARLOW: Ten thousand square miles -- Lake Erie.

MR. POSTON: Also what are some of the effects of these algal "blooms" that are on now? What do you know about this? How can you elaborate on this?

MR. HARLOW: I think there is a question later on that talks about this. As a matter of fact, I think we have already answered it to some extent about the fact that during the summertime we are getting these tremendous growths of blue-greens in the lake. These are the kinds that seem to spring up very suddenly in the summertime when the water gets warm and are the most obnoxious, and these are particularly troublesome at water supply intakes.

The blue-greens are also the algae in the lake that give it this pea-soup color. Also, during the summertime, we get these tremendous growths of Cladophora along the shoreline wherever we have a suitable growth for algae, for these clinging type algae. In fact, I would suggest that each of the Conferees, if they could take some time out, just might go swimming in Lake Erie. I did. I picked out one of those beaches that I thought was safe and I went swimming. In order to get into water that is swimmable, up around waist deep, you have got to wade through ankle-deep water for about 10 or 15 feet that is as thick as bread dough with algae. To me that is a problem and we have got to do something about it, and it stinks something awful.

MR. POSTON: Does this affect the water supplies?

MR. HARLOW: Well, it is affecting the water supplies right now in Cleveland.

MR. POSTON: How?

MR. HARLOW: They are reporting fairly serious tastes and odors and I think I mentioned this previously.

MR. STEIN: Let me go off the record a minute.

(Discussion off the record.)

MR. STEIN: Let's go back on the record.

Dr. Bartsch.

DR. BARTSCH: I don't want to prolong this meeting unnecessarily, but I think Mr. Weaver presented to us a good opportunity to make an observation that I think if you are not aware of it you ought to be. That is that you cannot really tell too much by looking at the production of algae for any given year, because like fishing and many other things there are good years and bad year. If you look at lakes -- not just Lake Erie but lakes in general -- you will find that sometimes if you have a cool year with a lot of rain, the amount of algal production is low. When you have dry years and low water, the algal production goes up. But if you have people development on the watershed or in the vicinity of the lakes, then you have a graphic situation which is something like the Dow Jones average.

If you want to plot it out month by month and year by year, you will find that there are ups and downs along the way related to these local, seasonal and annual conditions, but the general trend is continuously upward.

MR. STEIN: Mr. Eagle.

MR. EAGLE: Yes. I would like to comment that as far as the staff of the Ohio Water Pollution Control Board is concerned, we are very much aware of the algal problem in Lake Erie. We know that it is a nuisance. It is a very serious problem. It interferes with recreation; it is unsightly; and on occasion it causes a difficulty in our water treatment plants and our water supplies. Certainly Ohio is very much affected by this, and we are very much interested in trying to control and do something about it.

Now, the purpose of the question, I think, is primarily to bring out the fact that I think that we need a better base line than we have at the present time in the way of making a rather scientific observation and tests, and so on, hopefully, as we move forward in the future that we can be able to measure some of our progress.

DR. BARTSCH: I have no disagreement with that.

I think that is a logical and reasonable point of view. I think many times we have failed to do this thing when we should have.

MR. STEIN: I would like to make a comment. I would agree with that.

Now, it seems to me that we are faced in the algal problem with a lot of problems we have in the water pollution control field. When we do not have this precise data, people sometimes think we tend possibly to almost ask for too much because you need a safety factor, when you really don't know. Now, it seems to me that then we always have to equate what we are going to do in the program in the gathering of data, whether we hold up the remedial program until we have the data or we do the best we can on the judgment we have now -- the best scientific judgment -- and gather that data and refine that in the future.

MR. EAGLE: That was not my implication that we should hold up anything, but I do think we need better measurements of the progress that we hopefully wish to make.

MR. STEIN: Yes. But, George, let me ask you: What field in water pollution control don't we have that? Right now -- and I will be specific -- we have a large plant -- a large plant is going into St. Louis. For the first time, as far as I know, we have an extensive stream survey for a year before the plant goes into operation and a year after it, and this is something that you would have thought would have been done through the years to see what a plant in a major city really did. As far as I know, this hadn't really been done before. I hadn't been able to find it.

The point is, what you are saying about phosphates -- and I couldn't agree with you more -- I find is true about almost every area of water pollution control that we deal with.

MR. EAGLE: In many places in Ohio this has been done for many years. Cincinnati is an example. This has been going on for 30 years where we have been taking observations and tests on the river, and we have them for extensive periods before and after. So it is being done in many places, and I think that this is of such dire importance in Lake Erie that every effort should be made to get all of the scientific data we can.

MR. POSTON: I would say that I have lived in Cincinnati and I have watched them study the water in Cincinnati and the Ohio River, but I still go to Cincinnati and I find out how that water tastes down there, and I would submit that you have got to do more than study it.

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MR. EAGLE: Well, it doesn't taste as bad as it used to, Wally.

MR. STEIN: What we want to see is that Lake Erie water doesn't deteriorate so far that there is only one way to move and that is up.

If there aren't any other comments, then may we go on with Question 4, please?

MR. HALL: Question 4: What are the "natural" levels of phosphorus (soluble and total) in each of the Great Lakes? Do the lakes with lower phosphate levels have algal blooms?

MR. POSTON: George.

MR. HARLOW: Answer: The "natural" levels (and average levels) of phosphorus are difficult to determine in lakes because of phosphorus' instability chemically, organically, and physically. One can only estimate these levels based on averages of analyses by FWPCA, Bureau of Commercial Fisheries, and others, of midlake waters away from source areas as follows:

Lakes	Sol P. Total P (mg/l)
Superior	< .01/.01
Michigan	< .01/.01
Huron	< .01/.01
Erie	> .01/> .02
Ontario	.01/.02

The lakes with lower phosphate levels do have algal "blooms," in other words, in Lakes Superior and Michigan, diatoms occur in sheltered areas and/or along shore but the "blooms" do not anywhere near approach those occurring in Lake Erie. Also, the phosphate levels contributing to these blooms may possibly be higher than the "natural level" in each lake.

MR. STEIN: Are there any comments or questions?

MR. POOLE: Mr. Chairman.

MR. STEIN: Yes, Mr. Poole.

MR. POOLE: I just want to comment a little more on this "natural level."

I raised the question before and my original definition would have been the same as Dr. Bartsch said his would be, namely; if you are talking about natural level, you ought to go back to the time we had the Indians around the Great Lakes. Obviously we cannot do that, but I want everybody to understand that we are including soil runoff in natural levels, and this to me substantiates Mr. Eagle's plea on the previous question that we get a base line level here as quickly as we can, because I think I am safe in predicting that as agriculture intensifies, our natural levels are going to go up. If this is the case, and if we don't find some way of doing something about this, it can only mean one thing, and that is that we may be talking about 80 percent reduction for the artificial levels today, whereas 10 years from now we are going to have to think of 90 or 92 or 95, and so on, as we go up the scale.

MR. STEIN: Are there any comments on that?

MR. HARLOW: I am interested in knowing what was meant by the word "natural" here. George, you asked the question. Are you talking about the levels if you exclude domestic waste?

MR. EAGLE: Exclusive of domestic waste.

DR. STEPHAN: May I make a comment about this? There is some confusion over this term of natural level -- that is the reason we tried to place some explanatory information in the answer to the earlier question.

I wonder if perhaps it might clarify for us to use the term "background level" and "natural level," natural being what Fritz and Blucher said: when the Indians were here there was a certain amount of phosphorus in the lake, and that was natural and unaffected by the white man's activities. "Background level" might be a better term for that which is in the present state of development not readily controllable. This would presently include agricultural runoff.

MR. STEIN: Let me ask a question about that because I think that might be productive.

We use the term "background level" in working with radiation, as you know, but we are more stable. I do think that Mr. Poole and Mr. Eagle both have a significant point here in dealing with this, if we talk in terms of "background level."

If we are thinking of including agricultural land runoff and excluding domestic or industrial wastes, it is not quite going to be like radiation where you can stay at a relatively stable base. You are going to have to project yourself an increment each year as we get in agricultural activity in the runoff, isn't this correct?

DR. STEPHAN: I think this is correct, a natural level by this definition --

MR. STEIN: No. I am talking in terms of background.

DR. STEPHAN: Right.

MR. STEIN: But are you ready to buy a background that will be X, and in 10 years will be X plus 10-A, A standing for agriculture, and if you are ready to buy that, then what becomes of an 80 or a 70 or a 90 percent reduction in phosphates and what is the meaning? I think we really have a very interesting problem.

DR. STEPHAN: I think the analogy you are making with radiation is perhaps a reasonably adequate one. One would assume that the natural levels would remain constant because that is something that occurred historically and there it was. Background level, however, I quite agree, one would expect to change. There will be a background level this year and there was a background level 10 years ago, and there is a background level that is going to be here 10 years from now.

The means for accomplishing effective pollution control of the lake is going to have to take into account a changing background level, as you will see in the answer to one of the later questions. There will have to be some account taken of it.

MR. STEIN: Are there any other questions or comments?

If not, may we go to Question 5?

MR. HALL: Question 5: What are the phosphorus levels in the tributary streams? Is it adequate to permit a bloom to start in the tributary? Would such a bloom potential be realized in terms of a bloom in the lake?

MR. POSTON: George.

MR. HARLOW: Answer: Phosphorus levels in south shore streams, above lake-affected zones, based on averages of biweekly FWPCA sampling in 1967 are as follows:

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Stream	Total P (mg/l)
Maumee River	0.42
Portage River	0.44
Sandusky River	0.49
Huron River	0.62
Vermilion River	0.10
Black River	2.22
Rocky River	2.30
Cuyahoga River	2.32
Chagrin River	0.17
Grand River	0.09
Ashtabula River	0.07
Conneaut Creek	0.05
Cattaraugus Creek	0.12

The Detroit River, at the mouth in 1967 -- from data of the Detroit Program office -- averaged 0.09 mg/l total P, but was widely variable across its width with spot concentrations ranging from 0.03 to 0.35 mg/l. Considering only phosphorus, the levels in all tributaries are adequate to start "blooms." These bloom potentials can result in blooms in the lake although the full potential may not be realized because of the precipitation of phosphorus to sediments and the rapid dilution of inputs once in the lake.

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MR. STEIN: Are there any further questions?

MR. POSTON: I would like to as Dr. Bartsch to comment on this, and I think it is significant here that every one of these is higher than the concentration in the lake, and where does this phosphate go, then, Dr. Bartsch?

DR. BARTSCH: I think one comment I would like to make relative to this -- I am not sure what was intended in the question -- when I read the question first I wondered if it was asking: with these levels in rivers, why aren't there blooms in the rivers?

If this was intended, then, I think I should say this: that the kinds of algae which grow well in Lake Erie -- and I believe at the present time judging from some of the odor in the public water supply, someone said that this is realted to an amoeba -- I don't know -- but this kind of an amoeba, being an example, grows well in lakes. It does not grow well in rivers. The planktonic or free-floating blue-green algae, which are characteristic of lakes customarily, do not grow well in rivers. The slower the flow of the river the more like that these kinds will be present. This means, then, that even though there may be high nutrient levels, I would not expect to find tremendous blooms of these planktonic blue-green algae in the inflowing streams.

I think your reference to the high levels, Wally, would imply that this is a tremendous phosphorous input and that one would expect to find near the mouths of these rivers places where there might be fairly high production.

I think the answer to the question already has indicated that some of this phosphorus does not become involved in the biological cycle because if there are silt loads, it can carry some of it down to the bottom. There can also be some other mechanisms by which the phosphorus can be dispersed or precipitated or made unavailable for algal growth.

MR. OEMING: I just want to be sure I understood you correctly. There are two paths of fate for these things, their biological uptake and the sediment, is that what you said, or did I miss something?

DR. BARTSCH: Yes, there are more fates than that, more mechanisms than that. The one I mentioned was dispersion--when the water from a river empties into a lake, obviously it is going to disperse in the lake. So that these high concentrations of phosphorus will by dispersion produce lower concentration of phosphorus in a large volume of water. In addition, the phosphorus will be in part precipitated by sediment and other mechanisms. The third is the uptake by the biological system itself.

MR. STEIN: Are those precipitated phosphates lost to the biological system forevermore?

DR. BARTSCH: I think, Murray, there is an answer to that question in one of the later of the seventeen questions, but certainly not all of it is lost. Some of it is made available, then, through the turnover and the resolubilization of the phosphate compound.

MR. STEIN: Are there any other comments or questions? If not, let's go on to Question 6.

MR. HALL: Question 6: How was the recommended 80 percent reduction determined? The technical committee report assumed the per capita contribution of phosphorus and also assumed full dispersion in the lake.

MR. POSTON: George.

MR. HARLOW: Answer: At the June 4, 1968, meeting of the Lake Erie Conferees in Cleveland, 80 percent removal of phosphate as well as 92 percent removal of phosphorus was discussed by all the Conferees with no formal recommendation being made and no decision being reached. It was mentioned that the 80 percent consideration was based on achieving a similar agreement to that which was reached at the Lake Michigan Conference.

The 80 percent consideration was supported by

Mr. Oeming of Michigan and Mr. Poole of Indiana and a general consideration along these lines was concurred in by Pennsylvania. Ohio and New York, however, would not consider such a proposal.

It is our best understanding that the 80 percent recommendation for Lake Michigan was agreed upon because this was thought, at that time, to be a level of removal which could be achieved with assurance utilizing phosphate removal technology which was actually available. This is apparently also the basis upon which the State of Michigan has made their recommendations both on Lake Michigan and at Detroit.

MR. STEIN: Any comments or questions?

MR. OEMING: Mr. Chairman, I have a comment.

I am not sure that this is entirely responsive to the question, or what the writer had in mind. This only picks up in 1968, but if you will recall my earlier questions this morning, if you go back and look at the record of the conference, the original conference in 1965, you will find repeated reference by the biologists, the experts, that we needed .03 or less. That seemed to be the figure that was most reliable at the time -- this is phosphate.

Then you left it up to the States to determine what they needed to do -- these Conferees -- and Michigan went back and looked at the Detroit River and said in order to reach .03 with the level that it was now, it would require 80 percent removal of all of the contributors of sewage and wastes to the river. This includes industrial wastes.

Now, at that time and that was in 1966 -- the technology for phosphate removal was not at the level it is today, and yet it was determined at that time that for the Michigan situation we had to remove 80 percent to get to this level that the experts recommended. I think that is the origin at least so far as I am concerned of the 80 percent removal, and it was not tied to what was achievable at that time but what was necessary.

MR. STEIN: Right.

MR. POOLE: Question: Are you talking about .03 as what, PO_4?

MR. OEMING: That is right.

MR. STEIN: My recollection coincides with that. Let me check on that, because you recall when we talked about the 80 percent we weren't quite sure that the technology then could get it. In other words, we were shooting for -- we put a figure down that presumably was arrived at, where we would get concentrations of phosphorus which would reduce this critical nutrient and which we would be below what we considered reasonable nuisance conditions. Even though the technology hadn't come up to that point or we weren't sure of it then, we recognized that this had to be done, I think, from some of the other information we have. I hope they are right. Fortunately, the technology has overtaken us now and we think we can do it.

MR. EAGEL: Mr. Chairman.

MR. OEMING: May I further comment, so I can clear this up for the record here?

MR. STEIN: Yes.

MR. OEMING: That this 80 percent removal was based upon using one-third of the flow of the Detroit River. It was not the total flow of the Detroit River. And this is based on hydrological studies, and so on.

I just want to make it clear that the 80 percent that was established by Michigan here was felt, on the basis of the conference record, to take care of Michigan's obligation to Lake Erie, and I think that is where the 80 percent, so far as I am concerned, came from.

I don't recall that there was any 80 percent removal talked about in the original conference proceedings anywhere.

MR. EAGLE: I would like to have Mr. Harlow explain how he arrived at his 92 percent that was discussed, I believe, briefly on June 4.

MR. HARLOW: That is answered very explicitly, I think, in the next question, Question 8, George.

MR. EAGLE: All right.

MR. STEIN: As a matter of fact, I think the statement -- and correct me if I am wrong -- this 92 percent discussion by the Conferees, while it might be technically correct, was at least to my recollection not what I would call an extensive discussion.

MR. OEMING: No.

MR. STEIN: It may have been mentioned in passing.

MR. EAGLE: Well, Mr. Harlow had it in his report which was not presented.

MR. STEIN: Was not presented, and I don't know -- you know, I grew up in the old fashioned school. When you have a document in your pocket that you don't put in the record, I am not sure that was a discussion.

MR. EAGLE: It was distributed but not presented.

MR. STEIN: Are there any other comments or questions?

If not, may we go on to the next question?

MR. HALL: Question 7: The flow pattern of the Detroit River into Lake Erie demonstrates a stratification of the discharges, Detroit along the west bank and Windsor along the east. With an 80 percent reduction at Detroit, what will be the resultant phosphorus concentration downstream unless there is positive dispersion provided to insure utilization of the full river flow? Will it be adequate to trigger an algal bloom?

MR. POSTON: George.

MR. HARLOW: Answer: Using 0.35 mg/l (Detroit Program Office) as the maximum phosphorus concentration along the west shore of the river at the mouth, one could expect 80 percent reduction of present loading to attain a minimum concentration of 0.07 mg/l total phosphorus in this area decreasing to 0.03 at the center of the river. Concentrations in this range are sufficient to provide the phosphorus requirement for an algal crop considered as a "bloom" but not necessarily to trigger it. Further, the "blooms" would be less severe, less extensive and of less noxious species. One would expect these "blooms' to be perhaps similar in density to those commonly occurring now along the northeast Ohio shore.

MR. EAGLE: George, could you be more explicit as to where these are commonly occurring? Could you give us a few for instances?

MR. HARLOW: Where what is commonly occurring?

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MR. EAGLE: What you said in the last sentence.

MR. STEIN: "One would expect" --

MR. HARLOW: These are throughout the shoreline waters from the area along Painesville or Fairport Harbor east.

MR. EAGLE: Well, now, I would like to go back to the answer to Question 1. I don't think that this answer is quite compatible with the answer to Question 1, where you say that "Therefore, serious consideration should be given to greater than 80 percent reduction, since this is now feasible."

I would like to think we need to get it established at this point what is technologically feasible on a practical basis, I hope, at this time.

MR. STEIN: Dr. Stephan, do you want to try to address yourself to that question?

DR. STEPHAN: We can certainly go into that now, but that is covered in question number --

MR. EAGLE: If you wish to hold it it is alright with me.

DR. STEPHAN: I would like to hold that.

MR. STEIN: Why don't we hold that question because I think -- and let me make this point -- I think you have the questions developed in logical order, and I think Question 8 should be a basis for that next one, if we could wait. Thank you.

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Are there any other comments or questions?

Mr. Oeming.

MR. OEMING: Mr. Chairman, I think I am going to have to take exception to the answer because, as I mentioned previously here, a great deal of care and a great deal of computations were performed to reach the levels that are being required of Michigan industries and municipalities. The levels, as I spoke of, the foundation for this whole program on the Detroit River is .03 phosphorus as PO_4, and I cannot subscribe here to the 80 percent reduction which would result in .07. I think there has got to be another look taken at this.

Furthermore, we are not dealing in concentrations entirely, but in fixed numbers of total poundage of phosphorus. In addition to the 80 percent removal, the total poundage figure is put in there, so that whatever percentage is necessary will not exceed the ceiling figure.

MR. STEIN: Mr. Harlow, do you want to comment on that?

You know, while Mr. Harlow is coming up, I would like to make one comment. Your remarks, Mr. Oeming, on six and seven, I think, indicate to me at least procedurally why a meeting like this is desirable, because I think with the modification you had in six and the questions you had in seven, if those answers were left to stand and we weren't together, we might be off and running and take a long time to get us back. I think something like this can keep us more on the track.

Mr. Harlow.

MR. HARLOW: The way the answer was formulated, I think, is possibly an oversimplification to try to arrive at a concentration at the mouth of the Detroit River. I do know that Mr. Oeming did go through a rather sophisticated set of computations to arrive at what he thought the level should be. I cannot answer to his computations. I think that in order to really get to the meat of that question, you would need to know exactly how Mr. Oeming arrived at his calculation, and I don't know how that is.

MR. OEMING: I bring this up at this time because this is very significant here to this whole problem -- attacking this problem, Mr. Chairman, in that this was reported to the Conferees at least on one occasion and the Conferees subscribed to the Michigan program as adequate; and, secondly, I would like to question the "minimum concentration" in the third sentence -- "to attain minimum concentration of 0.07" with 80 percent removal on present levels.

Do you mean minimum or did you mean maximum?

MR. HARLOW: Actually the 0.07 is figured from the 0.35 and 80 percent reduction of the 0.35 will give you a 0.07.

MR. OEMING: Well, if that is the case, Mr. Chairman, all I can say, without prolonging this for weeks here, is that I would take exception to this answer.

MR. POOLE: Well, Mr. Chairman, if I am correct, the Michigan computation is on PO_4 and the FWPCA computations are on phosphorus, and if that assumption is right, well, we have got a considerable difference here and I think this is pretty damned important.

MR. STEIN: Is that assumption correct?

MR. HARLOW: Yes.

MR. POOLE: Take 3.0 times .07 and you get .21.

MR. STEIN: Well, it would seem to me that we should at least have computations for all of the times that we are working this on the same basis.

Now, is there anything wrong with using the PO_4 concept in working up your computations, or is it the same basis?

MR. OEMING: I would agree with the P concept, the phosphorus.

MR. STEIN: Now, the question I am getting at: If you use the same basis for your commutation, would there really be any difference between your statement and Michigan's statement here? Is there a substantive difference or is this just a difference in approaching it?

MR. HARLOW: I really cannot tell, because, I think, Mr. Stein, you have to go back to Michigan's original computations. I think the way we computed it is a very simplified approach, maybe oversimplified, and it is straightforward, 80 percent reduction of 0.35 will give you a 0.07 figure.

MR. STEIN: I don't mean to be legalistic, as this is a technical meeting, I know, and we want to leave this completely open and I don't mean to be legalistic, but Mr. Oeming did raise the question. He came forward with his computation. We looked at it. Our technical people went over it. The Conferees and the Federal Government endorsed the Michigan program.

Now, if there was doubt about their method of computations other than translating that into probably more universal terms, why didn't we bring this up before?

MR. HARLOW: I am not disagreeing with Mr. Oeming's statement at all. I think what I am saying here, if you followed it the way I calculated it, that is the answer you will get. I think there are many, many ways you can go through the mechanism of calculating how much phosphorus you should put in the lake to maintain a certain level of the lake. There are many, many ways you can calculate it to arrive at a level.

I think perhaps we just went through different ways of calculating and came up with different answers.

MR. STEIN: May I make a suggestion here, that we are going to put this in the record in questions and answers, that you attempt to get together with Mr. Oeming's staff and we attempt to come up with an answer to this, if we can, which both you and Mr. Oeming can subscribe to at least in figures?

If we cannot do that, then we should know it. But I think what we may be coming up here with is a difference which is caused by the way the calculation is made rather than the substantive difference.

MR. OEMING: Well, I think, Mr. Chairman, while I certainly have no objection to working with anybody, I think there is a basic problem here that is not going to be resolved by that, because there is at least one industry that has complied with the 80 percent-plus removal of phosphates already. Now, if we are going to change the rules in the middle of the game, we are never going to get phosphates out of that river.

We already have people under order. We have them working on programs. We are well along -- within a year or a year and a half -- of actual construction, in some cases, with plans drawn.

Now, how are we going to reverse this project and say, "Boys, we made a mistake. We have to do this all over again."

I am not happy with that.

MR. STEIN: I haven't heard the suggestion -- maybe it will come up later -- as to changing the rules.

MR. POOLE: Mr. Miller just reminded me that we think, at least, without having been involved in either of the computations that the discrepancies are not as great as they appear.

I think Mr. Harlow's was based on the maximum of .35 which, as I recall earlier, was the maximum that was measured in the Detroit River, and we believe the Michigan computations were based on annual averages and this in itself could acccunt for quite a difference, you see.

MR. STEIN: Would we agree, Mr. Oeming, without changing any of the rules or any proposal, that what we should do, if we have a difference just on the basis of computation, not on the basis of theory or difference in substance, that we should try to get these ironed out so the figures will be meaningful to both groups?

I have the feeling the same way, that a good portion of the difference here may be because the same methodology was not precisely used in arriving at the answer to the question.

MR. OEMING: Well, I would hope that was the difference, and I hope we are not changing the rules in the middle of the game, because that is fatal to pollution control.

MR. STEIN: If we are changing the rules, the Conferees will get together to do that. We are not going to do it here. But I hope we are not getting in -- as Joe Quinn used to say at one of the "technicating" sessions -- he used to say, "Here go the boys again, trisecting a BOD." I hope that we don't come up with that kind of difference.

If you both are saying about the same thing, let's try to see if we can get that together and maybe he can endorse your statement. I would suggest that before we go into eight, because this looks like a very juicy one, we recess for ten minutes.

(Short recess.)

MR. STEIN: Question 8.

MR. HALL: Question No. 8: The report

distributed by Mr. Harlow at the June 4, 1968, meeting recommended a 92 percent reduction. How justifiable is this calculation? If the 92 percent factor is correct, would the 80 percent program be ineffective?

MR. HARLOW: FWPCA would prefer to see all phosphorus of waste origin removed from wastewater entering Lake Erie. This is the only way to begin to return to a "natural" phosphorus level throughout the lake. In arriving at the 92 percent figure, FWPCA assumed, for reasons of practicality, that the runoff contributions of phosphorus will not be reduced but will probably increase from a present load of 33,000 lbs/day to a load of 42,000 lbs/day in the year 2020. That load of 42,000 lbs/day was then used as a base not to be exceeded. Assuming further that the present in-basin loading is 137,000 lbs/day, 95,000 lbs/day must be removed and all of it from the municipal and industrial loading of 104,000 lbs/day. This means then that this loading must be reduced to 9,000 lbs/day. Allowing Canada 1,000 lbs/day of this amount, the United States is left with 8,000 lbs/day, and, hence, a 92 percent reduction. With increasing volumes of waste, this goal will require essentially 100 percent removal of municipal and industrial waste phosphorus by the year 2020. It will also be necessary to develop and employ procedures for reducing phosphorus runoff from agricultural and other lands.

The calculation is justifiable on the basis that (1) 92 percent is near the current maximum feasible removal, (2) that attainment of a near-natural aging rate of Lake Erie is desirable, and (3) that the highest possible removal is now mandatory to stop the accumulation in the sediments of a rapidly enlarging nutrient reserve. It is felt that the reserve in bottom sediments is now sustaining the phosphorus level in Lake Erie in midlake from the islands eastward, mainly because this level is so constant, does not decrease eastward, and is slightly higher than the upper lakes.

The discharge from the lake is on the order of 40,000 lbs/day. By reducing the inputs to that amount, the western basin and shoreline waters should be brought near the concentrations of phosphorus found in midlake. If the inputs could be reduced to near that amount, the available nutrient reserve in the bottom sediments could begin to be drawn upon and algae populations would be reduced to levels capable of being sustained by the nutrient reserve. These populations will not be obnoxious because they are not now in midlake.

The 80 percent factor would not now be

"ineffective." Any removal at all would be beneficial because it would reduce the rate of accumulation of phosphorus in the lake. But lake improvement will not be directly proportional to removal rate. As 100 percent removal efficiency is approached, each percent of additional removal will have proportionately much greater effect than it will at lower removal efficiencies.

MR. STEIN: Any comment?

MR. EAGLE: Mr. Harlow, your present recommendation then is 92 percent -- we should be talking about 92 percent removal in the basin generally, right?

MR. HARLOW: Well, I think I would like to see as much as you can take out in municipal waste.

MR. EAGLE: You say that 92 percent is feasible?

MR. HARLOW: I think this is going to be discussed later on, on what is now feasible in municipal wastewater treatment plants by Dr. Stephan.

MR. STEIN: Now, let's see if I remember this record, so we don't get off.

I don't remember about the report distributed by Mr. Harlow. The report was not put into the conference proceedings, as I recall it, and the question of the amount to be removed, I hope, is the kind of profound policy judgment that will be made by the Conferees.

Questions and Answers

Now, I think we are in the situation with this phosphate removal involving some of the States here that the Conferees have not had unanimous agreement on a percentage removal. Lake Michigan agreed on a minimum of 80 percent removal. But since we have been working on this in Lake Erie, the technical advances have made additional removals more feasible. This is a question of equating what is feasible and what it is going to cost, etc.

But I think that any recommendation made on what should be removed should, if we follow our technique in Federal-State relations, try to be made by the States and the Federal Government unanimously. As far as I know, up to this time, the Federal Government has not put forth any recommendation to the Conferees as to a percentage removal.

MR. EAGLE: Well, Mr. Stein, I read the second paragraph as a recommendation.

MR. STEIN: Well, this is precisely why I said that.

No. The question here is -- and you know what we do -- all our technical people present their notion of what they are to do, as to their best judgment, except when we have a joint report, and then it becomes an institutional report. We have made no such recommendation as far as I look at the record on a percentage removal of phosphates from Lake Erie. We did not put any specific number into the official conference record. As far as I see this, this is a computation made by Mr. Harlow, and that is his view.

Are there any other comments or questions?

MR. BOGEDAIN: Yes, Mr. Stein. Bogedain, New York.

Back in the Technical Committee Report, some 6000 pounds per day, as an input by New York and Pennsylvania, is indicated. Could you give me what New York's contribution is estimated to be? This figure was lumped together. If it is not readily available, may I ask that you confirm it to our department at some later time?

MR. STEIN: Can we do that?

MR. HARLOW: Yes, we can.

MR. STEIN: You can't do it now?

MR. HARLOW: No, I don't have the basic data.

MR. STEIN: May I ask the technical question: Who is allowing Canada a thousand pounds a day?

MR. HARLOW: Maybe we should allow more for Canada.

MR. STEIN: I mean how did we do that?

MR. BOGEDAIN: I only wanted to know if this was confirmed with the Canadian Government.

Questions and Answers

MR. STEIN: Right. Let's leave this on the record. You know, I have been up -- possibly --

I guess any guy in the State Department can tell you this: Anything more difficult than Federal-State relations is foreign relations. But when I visit our Canadian friends, they get very sensitive about this stuff, allowing them X pounds -- Okay.

MR. BOGEDAIN: Another question.

Could you elucidate a little bit further on what you mean by the attainment of a "near-natural aging rate of Lake Erie"? What is the aging rate of Lake Erie?

MR. HARLOW: The natural aging rate?

MR. BOGEDAIN: Well, just pick any aging rate if you will.

MR. HARLOW: I think perhaps here that the words "aging rate" or the word "aging" is a rather loose term, and we have to go back to the fact that all lakes age naturally. Lake Erie's rate has accelerated to the extent that it is aging unnaturally. We want to go back to this natural rate, the rate that existed -- as close to that rate, anyway, that existed before we started using the term "white man," and by reducing phosphorus to the extent that we are discussing, we are going back as close as we can to that near natural rate.

MR. BOGEDAIN: But that near natural rate has not been nailed down.

MR. HARLOW: Well, we don't know what it was before the Indians.

MR. BOGEDAIN: Nor do we know it today.

MR. HARLOW: Well, this is not measured in that kind of numerical value that you can say Lake Erie has aged so much. It is aging unnaturally and by removing phosphorus we want to go back as close to the level of natural aging as possible.

MR. BOGEDAIN: In other words, it is purely your estimate as to what these conditions are which prevail now, or in the past, or at sometime in the future.

MR. HARLOW: I think it is anybody's estimate. We don't know how it existed before man came here.

MR. STEIN: Yes, Mr. Poston.

MR. POSTON: Mr. Chairman, you referred to the Lake Michigan Conference, and back in February of this year, Dr. Weinberger testified, and Dr. Weinberger indicated that you could remove phosphorus at, oh, almost any rate that you wanted to, up to a hundred percent if you used all of the available methods -- maybe distillation, or what-have-you. But the practical rate was 80 percent -- was the figure that I remember he put out, and I would like Dr. Stephan to comment on this if he would care to.

DR. STEPHAN: Once again, this is the subject of

Question 15. I would be happy to go to it if you would like.

MR. STEIN: No.

MR. POSTON: Maybe that would be the more appropriate time.

MR. STEIN: I didn't know you could distill phosphorus! I wondered what you drank the last time you came. (Laughter)

MR. RICHARDS: Mr. Chairman, I would like to comment that during the considerations of the Technical Committee, the Ohio represetnatives went through a calculation based on available information with respect to inputs of phosphates or phosphorus to the lake, and it was indicated that to attain a level that would meet the .01 parts per million of phosphorus would require over 90 percent reduction of the controllable increments of waste.

MR. STEIN: Does anyone want to comment on that?

Mr. Harlow, did you want to say anything?

Let me raise a question -- and I think we possibly should bring this up -- while the 92 figure wasn't put out, as I understood it, this was a computation based on Ohio personnel which seemed to fit in with this. Is this substantially correct?

MR. HARLOW: During the deliberations of the

Technical Committee, the Ohio member came forth with a calculation for removal of phosphorus to reduce the concentrations to the level proposed in the objectives, and Earl Richards is correct. I don't recall the exact figures because I didn't make the computations. It was in excess of 90 percent. However, I do know that it was done a different way from the way I made my calculations.

This material was not included, however, in the report of the Technical Committee.

MR. STEIN: Well, let's --

MR. HARLOW: I think if we are going to go into how it was calculated, I think you need to call on the Ohio people if it is necessary.

MR. STEIN: Unless you want to -- are there any further comments?

Let's see if we can go to Question 9.

MR. HALL: Question 9: If the algal bloom problem is in the western lake, why is the contribution east of the islands being considered in the calculations to determine required percentage reduction?

MR. POSTON: George.

MR. HARLOW: Answer: The algal "bloom" problem occurs in the nearshore area throughout the lake and occasionally in midlake. _Cladophora_ is a problem everywhere there is a proper substrate and depth, usually in nearshore areas. The aim in reduction of phosphorus is not to make the algal problem uniform but to lessen it everywhere.

MR. STEIN: Questions or comments?

Ten.

MR. HALL: Question No. 10: The proposed percentage reductions were based on annual average concentration for phosphorus. Is this realistic? Since the contribution of wastewaters from municipalities is constant throughout the year and the blooms are seasonal, the triggering mechanism must be something other than an annual average concentration of phosphorus. What are the concentrations of total and soluble phosphate before, during and after a bloom? How are these concentrations related to the computed annual average reduction?

MR. POSTON: Could I ask Dr. Bartsch to comment on this?

DR. BARTSCH: Answer: The triggering mechanisms that determine when substantial algal growth occurs are largely related to physical characteristics of seasonal nature, that is, solar radiation, length of day, temperature, turbulence, and so on. The size of the crop is more likely governed by nutrient availability. Nutrient availability is related to the load of phosphorus discharged to the lake over a long period of time such as, for example, a year. Therefore, it is the amount of phosphorus discharged annually that is important and this is, of course, related to the average removal efficiency achieved annually. The calculations referred to in Question 8 lead to the conclusion that the treatment efficiency should average 92 percent annually. In fact, even high removals during the period just prior to and during the growing season would be desirable.

The concentrations of total phosphate in the lake should not change materially with or without a bloom. Soluble phosphate concentration in lake water should be higher before a bloom, low during a bloom and rising after a bloom. Exact concentrations related to algal populations in Lake Erie are not known. Calculations used in reduction calculations are annual averages of analyses. Their relation to average input reduction can only be estimated. The concentrations before, during and after a bloom have not been directly related to the computed annual average reduction.

MR. STEIN: Any comments or questions on this? If not, thank you very much, Dr. Bartsch.

DR. BARTSCH: Mr. Chairman, as long as I am here, with your permission, I would like to philosophize a little on the last question and in particular the reference to anticipated increase in inputs from agricultural land, for example.

I think that while it may be necessary to take a dismal view toward this runoff increasing in the future, I think it also points up the need that over the long range this is an area in which we need to develop some control procedures also.

In relation to the reference to natural aging process, I think we should all pay attention to the fact that we are in difficulty in many of the hundred thousand small lakes in this country which have reached eutrophication stages which are objectionable solely as the result of the natural process.

So far as Lake Erie is concerned, this means then that over the long haul and weather, in three or four or five generations from now, we are going to have to begin to think about slowing down the rate beyond that which we can consider natural.

MR. STEIN: Thank you.

Are there any comments or questions?

I hope you are right, Dr. Bartsch, that this doesn't come to reality or just remains a dismal view, because we have an extensive area that we call the dismal swamp back east.

Questions and Answers

Will you go on with Question 11?

MR. HALL: The primary algal problems in Lake Erie are blooms of Cladophora, blue-greens in August and the "pea soup" earlier. Do the phosphorus requirements differ for these? What is the particular triggering agent for each? What is the role of the physical aspects of the western lake (depth, light penetration, temperature, anchorages, bottom composition, etc.) which might control or promote the bloom in this area as compared to the central or eastern basins?

MR. POSTON: Dr. Bartsch, do you want to comment on that one?

DR. BARTSCH: Answer: Phosphorus requirements do differ for different species of algae; however, the concentrations found in Lake Erie surpass the limiting requirements. For example, the phosphorus requirement for blue-greens is relatively high while for Cladophora it is relatively low. The triggering agent for blooms is complex and has not, as yet, been basically described. The science of algal physiology has not yet answered this question but it is apparent that the physical aspects are important:

Depth, related to light penetration, influences the volume/area participation in photosynthesis and, therefore, algal production.

Questions and Answers

Temperature dependence is known only in a general way. Increases in temperature produce two effects: changing algal population composition and increasing production. Temperature increases favor the growth of blue-green species.

Anchorages are necessary if Cladophora is to grow in profusion.

Bottom composition is principally important in relation to recycling of nutrients during periods of rapid consumption.

There is probably not a single "triggering" agent for each species of algae. If there is one, it is the latest agent to reach an optimum after all other requirements have reached an optimum level. That triggering agent can, therefore, be any one of many (e.g., light intensity, temperature, water motion, depth, phosophorus concentration, nitrogen content, pH, or any of a multitude of required trace elements or compounds).

The physical aspects of western Lake Erie are such that they promote greater algal growth than elsewhere in the lake. The western basin water has a theoretical average residence time of only about 50 days because of its small volume and high inflow. This residence time is reduced to much less than the average during times of high flow in spring and early summer. During times of high inflow the concentrations of phosphorus in that inflow are also high, leading to a rise in nutrient content in the western basin. These times are also times of high silt input coupled with increased wave-stirring of bottom muds, therefore transparency is less. Wave stirring also brings nutrients from the bottom into suspension. At the same time the western basin water is warming rapidly. Under normal circumstances the conditions of ideal nutrient supply, temperature, calmness and water clarity are soon set up and productivity is stimulated. Plankton will increase rapidly and attached algae will abound on the extensive shallow rock surfaces of the western basin.

The deeper, clearer waters of the central and eastern basins are over most of their area much less or not at all affected by similar physical aspects. Turbidity is less, temperature rise is slower, wave-stirring of muds is insignificant, retention time is long and shallow reefs are scarce. However, along the shore, particularly the south shore, conditions are approached which are similar to those of the western basin. Algal production is thus similarly stimulated.

MR. STEIN: Thank you.

Are there any comments or questions?

MR. POOLE: I have a comment for clarification, Mr. Chairman.

Questions and Answers

I don't quite understand, Fritz, how you have, say, during times of high inflow, a concentration of phosphorus when the inflow is also high. To me this can mean that it has to come from soil runoff if that is the case.

DR. BARTSCH: I think it has reference to that, yes.

MR. POOLE: But does the record actually indicate that during high inflow we do have high phosphorus.

DR. BARTSCH: Yes, this is my understanding.

MR. STEIN: By the way, this was a tremendous piece of writing, Fritz. We are going to give all these people who sat through this a graduate degree. This is very good.

DR. BARTSCH: I must admit with respect to this question my input was only about one-third of the work.

MR. STEIN: Well, whoever did it, this is a classic. Thanks.

Any other comments or questions?

Twelve.

MR. HALL: Question 12: The estimated discharge from Lake Huron is 20,000 pounds per day. This means an average of 0.02 mg/l in the flow of the Detroit River. The recommended limit for phosphorus in the western basin is

0.025 mg/l and in the central basin is 0.015 mg/l. Reported concentrations in Lake Huron exceeded .03 mg/l. How do you reconcile these objectives?

MR. POSTON: George.

MR. HARLOW: Answer: It is stated in the nutrient report to the Conferees that the discharge from Lake Huron is less than 20,000 lbs/day. This figure was estimated high intentionally. However, 1967 data from the FWPCA Detroit Program Office from repetitive sampling at the head of the St. Clair River indicate that the estimate is approximately correct for phosphorus. In Lake Huron, phosphorus data from the same office indicate an annual average concentration of about 0.01 mg/l. The recommended limit for phosphorus concentration in the western basin allows for a considerable additional input from in-basin sources coupled with natural phosphorus precipitation and algae utilization. The objectives are, therefore, not inconsistent if the value for Lake Huron of .03 mg/l is considered erroneous.

MR. STEIN: Are there any comments or questions? If not, may we go on with Question 13.

MR. HALL: Question 13: Mr. Harlow's recommendation is to limit the municipal contribution to 8,000 pounds per day for all the basin states. With an 80 percent reduction in the Detroit discharge what would be the Detroit contribution and how much of the 8,000 pounds would Detroit take?

MR. HARLOW: Answer: This is straightforward.

MR. STEIN: I hope all your answers are!

MR. HARLOW: Maybe too much so!

The Detroit metropolitan area discharge of an estimated 40,000 lbs/day reduced by 80 percent is 8,000 lbs/day, which of course is all of the recommended limit. However the question has combined two recommendations as one. My recommendation also calls for 92 percent reduction, thus reducing the detroit area contribution to 3,200 lbs/day. Its proportionate share of allowable discharge would be approximately the same as its share of the present total load.

MR. STEIN: Are there any questions or comments?

MR. EAGLE: Yes.

Is it true, Mr. Harlow, that if we stayed with this 80 percent figure at Detroit, then everywhere else we would have to go to a hundred percent to come down to the 8,000 pounds per day, right?

MR. HARLOW: I don't know, George. You said everywhere else.

MR. EAGLE: Everywhere else on Lake Erie.

There would be no allowable discharges from anywhere else because the Detroit area would have used the entire 8000 pounds, right?

MR. HARLOW: If you adopted this 80 percent.

MR. EAGLE: Yes.

I wanted to make this point clear and --

MR. HARLOW: This is only my recommendation. It is certainly up to the Conferees to decide.

MR. STEIN: Can you answer the question though? Is that substantially correct? If Detroit were to put out this 80 percent, the other discharges would be required to be reduced substantially a hundred percent in approaching it.

MR. HARLOW: Well, if it was agreed upon that you would reduce to 8000 pounds per day, and if Detroit removed 80 percent, they would remove down to the 8000.

MR. EAGLE: Just checking your calculations in another way, this would be, according to your calculations, a hundred percent for other discharges to Lake Erie if Detroit only reduced by 80 percent and you met the 8000 total.

MR. HARLOW: Based on the method by which I calculated it.

MR. POSTON: Of course, this also assumes that the load coming down the Detroit River remains a constant -- or coming down the St. Clair River.

MR. EAGLE: This is my second question then: Does it necessarily need to remain a constant? Aren't we reducing in the other Great Lakes areas also? Have you made any calculations on that, George, what that might be reduced to?

MR. HARLOW: In the other Great Lakes?

MR. EAGLE: Yes.

MR. HARLOW: No, I haven't.

MR. EAGLE: My question is: Do we have to continue to accept this discharge from Lake Huron? I mean is it logical to consider it?

MR. HARLOW: Whether it is going to stay 20,000 from now on?

MR. EAGLE: Yes.

MR. HARLOW: I would hope that the level would go down. As I understand it, there are other control programs going on elsewhere that should reduce the level of phosphorus throughout all of the Great Lakes.

MR. STEIN: I think it is fair to say here that as much as we love Oeming and Remus in Detroit, the likelihood of the Federal Government coming up with a requirement that they only have to reduce 80 percent and the State of Ohio has to reduce a hundred percent is remote.

Now, what we are trying to do, and we know this isn't perfect, but it is the kind of a thing with municipal treatment anyway -- I would hope we would come up with a uniform requirement that will apply to all, unless there are persuasive reasons that make different classifications. I have been out here, coming back and forth a long time, and I can't really make a distinction between Michigan and Ohio as to the kind of treatment they should put in when they discharge to Lake Erie.

MR. EAGLE: Well, I think, Mr. Chairman, this will explain a little further my reluctance on June 4 to come to an immediate agreement on 80 percent reduction, because I don't think that is enough. I think if we are talking about controlling algae in Lake Erie, then we are going to have to go considerably above 80 percent and we are going to have to do a lot of other things, including agricultural drainage, and so on. So, although I have been accused of foot-dragging, certainly, believe me, this is not Ohio's intent, and if we can arrive at a reasonable program, certainly we will be in there with flying colors.

MR. STEIN: Well, I am sure no one ever said Ohio is dragging its feet. But I think one thing we can discount right here, and I think we can all do that, is that in the States getting together or the State and Federal Government that we can't conceivably, any of us, live with one requirement for a city in one State and another in another State. I think we pretty much have to go down the line on this together.

Are there any other comments or questions?

Question 14.

MR. HALL: Question 14: What documentation is available to show the role of phosphorus in the bottom muds in algal formation?

MR. POSTON: Dr. Bartsch was going to account for No. 14.

DR. BARTSCH: Answer: The role of bottom muds is that of providing a nutrient reserve which feeds the overlying water. Although the release of mud-contained nutrients is essentially incessant, it is by no means constant in amount. Special conditions of EH, pH and DO content near the interface can cause very rapid release. These rapid rises of nutrients in overlying water occur when the water is temperature-stratified and DO is low or absent. Some of these nutrients migrate upward to surface waters through the hypolimnion and some are mixed throughout at the time of autumn turnover. The nutrients released to the water stimulate algal growth wherever there is adequate light, including the hypolimnion. There is much documentation

Attachment 1

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available to show the mechanics of release of phosphorus from bottom sediments and its effect on algal "formation."

Delineating the role of bottom sediments in algal production is the objective of a number of research efforts. The ten references given in Attachment 1 relate to this subject. In addition, FWPCA's National Eutrophication Research Program will publish a critical review of the literature on this subject area under title "Release and Uptake of Nutrients by Bottom Sediments Chemical and Physical Processes" in January 1969.

MR. STEIN: Thank you.

Are there any comments or questions?

MR. OEMING: I would like to ask Dr. Bartsch a question.

You are aware, aren't you, Dr. Bartsch, of the studies that were made back several years ago, which showed -- I have forgotten how many thousand acres of area in the bottom of Lake Erie opposite Cleveland that were oxygen deficient in the bottom layer Do you remember that, or are you aware of that?

DR. BARTSCH: Yes, I am aware that there have been these areas in Lake Erie which annually become oxygen deficient. I do not know the details from my own knowledge.

MR. OEMING: There is some area out of there --

40,000 acres, or miles, or square miles or something.

This would mean, applying what you have said here, that there is a nucleus of a problem right in the central lake, in the central basin, I guess, isn't it, that is east of Point Pelee where you would have a nucleus of a release of materials from the bottom sediments. This would be quite a sizable contribution here.

DR. BARTSCH: I would consider this to be a potential contribution which would be triggered by the anaerobic conditions in the sediment surface and it would then depend upon whether the current patterns were such as to bring this phosphorus into circulation to the levels where it could be utilized by the algae.

MR. OEMING: Don't go away. But, Mr. Harlow, can you remember how much of the area in the central basin was oxygen deficient from your studies?

MR. HARLOW: Twenty-five hundred square miles.

MR. OEMING: Twenty-five hundred square miles of oxygen deficient area, and this is then the central basin. We have been talking about the western basin which is bad, but here is another potential area of trouble, isn't it?

DR. BARTSCH: This makes the very point that -- one of several points that we attempted to make earier -- that we have to consider the input on an annual basis rather than the existence solely at the time that there are blooms. It also makes the other point that if we are going to cleanse this lake, we have to create circumstances that will bring the nutrients out of the sediments and get them also out of the lake, or at least get them out of the surface film of the sediment so that they are no longer a participant on the total nutrient cycle.

MR. EAGEL: This was only below the thermocline. I want to make this clear for the record that we are talking about below the thermocline and not the total water supply.

MR. OEMING: Yes.

MR. EAGLE: I have a question. I would like to ask Harlow, I guess. George, these studies that are being carried on by the Corps of Engineers in connection with their dumping of dredgings in the Lake Erie -- is the nutrient phosphate problem being monitored or checked in connection with these studies, and, if so, what kind of discharges are we getting from these?

MR. HARLOW: The nutrient content of the spoil from the Corps of Engineers dredging program is being monitored both by our agency and the U.S. Lake Survey.

Harbors were divided up. They took so many and made measurements and we took some. Our office emphasized the Cuyahoga area because it happened to be part of the pilot plant program of the Corps. This was an area in which they had a pilot dike under study, and we did make measurements of the nutrients that were contained -- concentrations that were contained in the dredgings as they went to the lake.

MR. EAGLE: Wouldn't these dredgings from the Cuyahoga River be very high in nutrients?

MR. HARLOW: Yes, they are.

MR. EAGLE: And they are just being dumped into Lake Erie, aren't they?

MR. HARLOW: The Corps is intending to put all this inside the dike this fall and a portion of this was put inside the dike this year.

MR. EAGLE: But it still leads into the lake, doesn't it?

MR. HARLOW: I think most of it stays in the dike and ends up in the sediment in the dike. The Corps is also planning to build a new dike.

MR. EAGLE: I challenge that. Do you have data to prove this -- that it does stay within the dike?

MR. HARLOW: We have data that leads us to believe that a heavy load of the phosphorus that goes inside the dike stays in the dike.

Now, I caution you on this kind of determination.

This dike has only been built just recently and the data were obtained just recently.

MR. BOGEDAIN: As the result of your determinations, what order of magnitude are the orders of phosphorus in these dredgings?

MR. HARLOW: I can't recall offhand.

MR. BOGEDAIN: You said they were high. How high?

MR. EAGLE: You have got 2.2 in the Cuyahoga River.

MR. STEIN: The question we always come around to here -- and I wish a Corps man were her to speak for himself -- but you don't only have to deal with the concentration in the dredging, when you compare the volume of these dredgings dumped with what comes from the cities and the industry it isn't very much, not that that shouldn't be taken care of, but, again, we have looked at this -- in Lake Michigan.

MR. BOGEDAIN: Mr. Chairman, you made my point. Thank you.

MR. STEIN: I will give you my view on that. I don't think that pollution from dredging is one of the tremendous factors in pollution in the lake. Now, I have made it also clear that my personal position on this is that I don't think we should clean up the lakes just to make them a dump and every contribution, large and small, has to be taken out.

Are there any -- oh, Mr. Poole.

MR. POOLE: Fritz, I want to come back to this 2500 miles in the middle of the lake, because as I said in this document I got the impression that the algae content in the central and the eastern portion of the lake is much less than it is in the western portion, and, well, we will say down almost to tolerable levels. As I read through this yesterday, then, the question came to my mind: How did we get this 2500 miles out in the middle of the lake? Where did it come from?

DR. BARTSCH: Well, I may have to call on George Harlow to assist me in an answer. But let me say at least this much: That the development of anaerobic conditions in the bottom of the lake are commonly an aftermath of the production of tremendously large crops of organic matter, whether they are good algae or bad algae, or animal plankton, and these crops of organic material, when they die, settle to the bottom and become a part of the sediment itself. This organic matter drawing on the oxygen resources of the water which becomes trapped in the hypolimnion is set off from the circulations with the overlying water.

Now, perhaps one of the reasons for what appears to be a discrepancy here -- the low DO on the one hand and the lack of tremendous blooms on the other -- is the distance of communication between whatever exchange occurs in the bottom sediments and the area in which the algae can grow.

Maybe George can comment further on this. I think this is perhaps the best I can do.

MR. STEIN: Say, Fritz, before you get off, what does "hypolimnion" mean?

DR. BARTSCH: Well, the hypolimnion is the name given to one of the three layers which become established in a lake as the temperature increases in the summertime, so that you have at the surface layer the epilimnion, which is a layer in which the wind is able to circulate the water, and the temperature in this layer is uniform and generally it is the highest temperature you will find in the lake. This is the area where the production of algae typically is going on. Then, if you measured the temperature with increasing depth, you would find that there becomes a rapid drop in temperature, and by definition to be the next layer which is called the thermocline. This temperature drop has to be one degree Centigrade per liter of depth. Once you get through this layer, you will find a layer where the temperature is uniform but lower than the surface water. This is the hypolimnion. This is cut off by the thermocline from the wind and circulation of the surface water. It becomes a sort of storehouse for nutrients that are typically not put to use by the biological system.

MR. STEIN: One thing I know, all these people are smarter than I am! They used the terms before of Eh, pH and DO. Do you want to explain that Eh?

DR. BARTSCH: Maybe George can do it better than I can.

It refers to electromotive force of the electromotive situation in the bottom sediments as it is applied here. If I remember the figures from some of my people correctly, when you have a potential charge there of about two-tenths of a volt -- someone will correct me if I am wrong, I hope -- you have an electrical circumstance in the environment that is conducive to bringing about solubilization of the phosphorous compounds.

MR. STEIN: You know, it shows you how much you learn. Before I came here, I thought Eh was a Broadway show last year.

George, do you want to continue?

MR. HARLOW: I don't know if I can add to anything that Dr. Bartsch said; he always says it so well.

I think, Blucher, however, a partial answer to what you said: The reason we get the low DO in the central basin and don't get it in the western basin is because we don't ordinarily develop thermocline in the western basin because the water is shallow. If we had a thermocline in the western basin, I think we would get a similar DO complex.

MR. POOLE: I can buy all that, and I don't want to belabor it. I know that the low DO comes from all kinds of organics that are down there, but I can't visualize the sludge from Detroit, and Toledo, and Cleveland getting out there into the middle of the lake in such quantity as to do this. So the only thing I can conclude is that this 25 miles is due basically to dead algae. Now, maybe that conclusion is wrong, but that has been mine, and then when you come along and make the inference that we have got tolerable algal levels in the central and eastern basin --

MR. HARLOW: Surface waters.

MR. POOLE: -- I begin to wonder if we have or not.

MR. HARLOW: Surface waters in the central and eastern basin.

MR. POOLE: Well, are they tolerable, if there are enough of them that when they settle and start decomposing they give you 25 hundred miles in the middle of the lake with no DO?

MR. HARLOW: A lot of the algae growing along the western shore find their way to the hypolimnion in the central waters.

MR. POOLE: I will accept it for the time being.

MR. STEIN: Fifteen.

MR. HALL: Question 15: What places in the United States are now reducing phosphates as a routine part of the treatment? What volumes, concentrations in the influent and the effluent, and methods of treatment are utilized? What are the unit costs, construction and operation?

MR. POSTON: Dr. Stephan.

DR. STEPHAN: Answer: Full-scale -- from some of your earlier comments, you have all been waiting on the answer to this one.

Full-scale waste treatment plants designed and operated specifically for high phosphate removal are now in routine operation at South Lake Tahoe, California (7.5 mgd), Prince William County, Virginia (1 mgd), Amarillo, Texas (13 mgd), Chicago (Hanover Park), Illinois (1 mgd), Las Vegas, Nevada (1 mgd), and Lansdale, Pennsylvania (about .03 mgd) -- there is a typographical error in the written answer -- Two small package plants (30,000 and

80,000 gpd) are also in fulltime operation at Kinzua Reservoir, Pennsylvania. Full-scale plants at San Antonio, Texas (24 mgd) and at Baltimore, Maryland (20 mgd), while not specifically designed for phosphorus removal, are also achieving high efficiency phosphorus treatment quite routinely. In addition to these installations, pilot plants for phosphate removal are in full operation at present at Nassau County, Long Island, New York (.5 mgd), Detroit, Michigan (.1 mgd), Washington, D.C. (.1 mgd), Lancaster, California (.07 mgd) and Ely, Minnesota (.02 mgd). Further full-scale demonstrations have been conducted and completed at Pomona, California (2 mgd), Washington C.H., Ohio (1 mgd), Xenia, Ohio (1 mgd), Grayling, Michigan (.3 mgd), and Lake Odessa, Michigan, (.5 mgd); and full-scale operations are under design or construction at Colorado Springs, Colorado (2 mgd), E. Chicago, Indiana (.5 mgd), Dallas, Texas (.5 mgd), Piscataway, Maryland (5 mgd), Lancaster, California (.5 mgd), Santee, California (2 mgd), State College, Pennsylvania (2 mgd), Grayling, Michigan (.3 mgd), Holland, Michigan (4.5 mgd), Elkhart, Indiana (20 mgd), and Rochester, New York (100 mgd).

The variety of processes utilized, flow rates treated, geographic locations involved and feed compositions handled make it difficult to provide any brief and simple summary of process costs and performances achieved. In most cases also it is not clear how to assign any definite fraction of cost to "phosphorus removal." This is because the selected process may shorten conventional detention time or improve other treatment objectives either deliberately or as a side benefit. Also of importance in costing is whether phosphorus control is to be incorporated into existing structures or planned into the design of new treatment facilities. It should be clear that the actual costs encountered at any given location can only be defined through an engineering analysis at the specific site.

For most of the cited cities as well as for a number of other examples of phosphorus removal technology, the processes utilized, costs and performances were reported in detail at the two FWPCA Workshops on Phosphorus Removal, May 1-2 and June 26-27, 1968, in Chicago, Illinois. Copies of the programs for these two workshops are attached and copies of many of the reports presented are available from participants. These reports of actual installations and available technology really provide the requested details on process, performance and costs.

In summary, however, it may be stated that 80 percent phosphorus removal may be readily achieved by a variety of processes for a total cost, including capital amortization, of 5¢/1000 gal. or less. This statement is conservative -- the workshop presentations indicate that lower costs (perhaps 3¢/1000 gal.) and higher efficiencies (up to 95 percent removal) may well be achieved. Using chemical precipitation with lime, for example, a 90-95 percent removal can be accomplished in a typical 10 mgd plant for less than 5¢/1000 gal. beyond the cost of a well operated secondary plant. The attached figure summarizes the cost projections for this process.

If you will refer to two pages over, the chart there indicating the treatment costs versus design capacity, it has four lines. The line sloping upward sharply to the right is the capital cost, (reading) capital cost in millions of dollars. The other three figures relate to treatment cost in cents per thousand gallons, the upper one marked T being the total cost; the O and M, the operating and maintenance cost; and A is

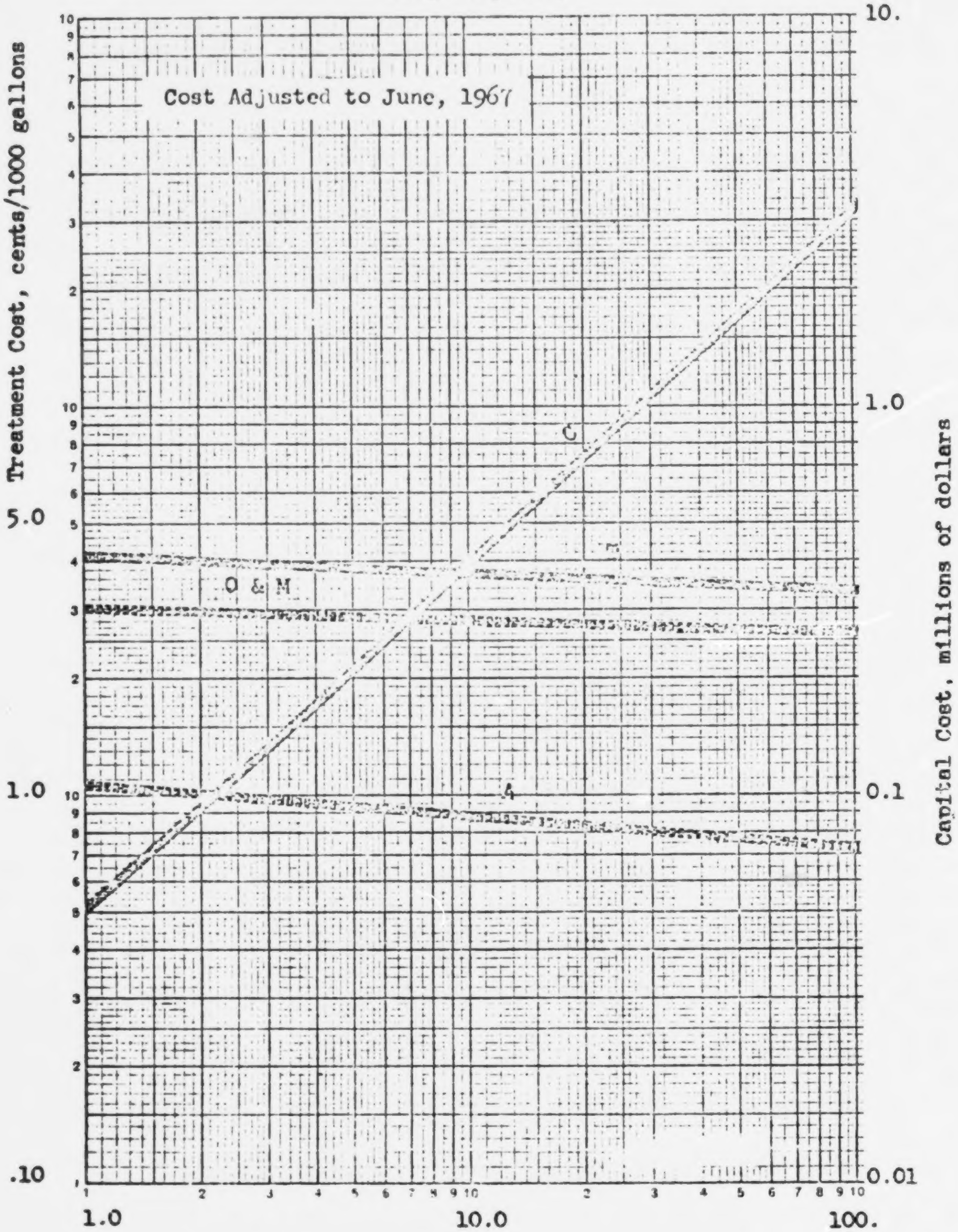
MR. STEIN: Thank you.

Any comments or questions?

(The above-referred to chart follows.)

Figure 3. SOLIDS REMOVAL BY COAGULATION & SEDIMENTATION

Capital Cost, Operating & Maintenance Cost, Debt Service
vs.
Design Capacity



C = Capital Cost, millions of dollars
A = Debt Service, cents per 1000 gallons(4 1/2 - 25 yr.)
O & M = Operating and Maintenance Cost, cents per 1000 gallons
T = Total Treatment Cost, cents per 1000 gallons

MR. BOGEDAIN: Yes, Mr. Chairman.

The factor of, let us say, 5¢/1000 gal. -- this is a cost per thousand gallons actually treated, not necessarily the rate of plant capacity, so this might mean for a 1 mgd plant, what, $50 per day?

Has any attempt been made to estimate the overall costs throughout the basin for certain phosphorus removal as to what could be incurred in, let's say, 80 percent phosphorus removal? Are those figures available?

DR. STEPHAN: You are talking about summing up all of the treatment plants in the basin. I have not done it.

MR. BOGEDAIN: The question would be: What would our taxpayers be asked to pay?

DR. STEPHAN: While a total has not been made, it could. If you equate this to a unit cost, per capita per day, five cents per thousand gallons is roughly three-quarters of a penny per day per capita.

MR. OEMING: Are you through?

MR. BOGEDAIN: Yes.

MR. OEMING: Mr. Chairman, there is a couple of experiences here that we have been having -- you mentioned, Dr. Stephan -- and while I wouldn't say that these were high type installations, these were put in as interim to see what we could do. They are full-scale but they are not designed and all set up and everything operating perfectly. But I think this caution ought to be thrown in, that while performances in the range of 90 to 92 percent were attained, this would not be a consistent removal -- that is, if you are talking now about monthly averages, and I don't know what we are talking about here -- if we are talking 92 percent -- it has been thrown out here as an objective.

Certainly that is going to be an average, isn't it? In order to achieve that you are going to be talking about 99-plus maybe, at the top, and 10 percent below that, as a variation, and the thing that I want to caution you about is when you are talking 92 percent, if you are talking an average, I question whether you are going -- we haven't seen anything that you are going to get that yet, and in Detroit the same thing. Trying limes and trying aluminum compounds and iron compounds is a routine thing.

MR. STEIN: Mr. Stephan.

DR. STEPHAN: Right.

MR. STEIN: Doctor -- I am sorry.

DR. STEPHAN: One point I would like to make clear: The degree of removal attained is dependent quite highly on the type of treatment process that is employed.

Now, there are several generalized types of treatment when you are considering phosphorus removal. One might be characterized as the biological uptake or the biological treatment process; typical of these would be the two I mentioned at San Antonio and at Baltimore, Maryland.

Now, there the removals have been, as you suggest, quite variable at times. Again, forgive me, I don't have the exact details in my head, but my recollection is at San Antonio the plant removal, as mentioned, is from about 60 percent up to as high as 90, maybe 95 percent, and that is quite variable. For that type of system, we don't know enough about it at this point to control the level to anything other than perhaps a long-term average of 80 percent, and I think we could probably achieve that but we couldn't control it on any given day or any given season.

On the other hand, as you go into what I would consider on the other extreme of the types of treatment, the strictly chemical type of removal, and this is exemplified by the one I chose to give for detailed example here -- the lime precipitation as a tertiary treatment process following existing primary-secondary. There I believe that we can -- and, in fact, we are in pilot-scale equipment and I suspect they are achieving it now at South Lake Tahoe in fullscale -- we can achieve essentially whatever degree of phosphorus removal you care to program into it, up to this maximum level of 90-95 percent. I think we could hold it at least at 90 percent. I think we could go to 95 with no particular difficulty.

Now, the reason for this is what when you get into the chemical types of treatment, the parameters which affect removal are much better known than they are in the biological treatment of sediments. We know if we control the pH; and if we control the dosage with respect to the alkalinity that we can precipitate out—in the type of system here -- all the phosphorus in this 90 to 95 percent range, I think, with a high degree of reliance.

The plant at Tahoe -- I have not seen their data -- I was out there in May and they were achieving this sort of removal quite routinely then.

MR. OEMING: But you did say, Dr. Stephan -- and I listened very carefully -- that you were still talking about the maximum that is achievable now, that you have some certainty about. This is not an average on 30 days or 90 days or anything like that, except in a special case in Tahoe.

DR. STEPHAN: I am not quite sure I understand your question. At Tahoe the removals are in the 90 to 95 percent range.

MR. OEMING: But the ranges elsewhere are wider than that.

Questions and Answers

DR. STEPHAN: Yes, quite dependent on the type of process, that is correct.

MR. OEMING: This is our experience, and I think also there is this about it? That we are finding that in certain cases, depending upon the type of sewage you have, that you cannot just go out and say you have got to process and go ahead and design it. I have in mind one particular case in the Lake Michigan basin where we have a combination of cherry cannery wastes plus sewage, and nobody has yet found -- and I think none of us have any confidence of what we know today without a demonstration project. We wouldn't know how to design a plant to even achieve 80 percent on the average.

DR. STEPHAN: Of course, I can't speak on individual cases I am not familiar with.

MR. OEMING: I think you are going to have a lot of indidivual cases.

DR. STEPHAN: I think my point would be the same: Every one is an individual case. But I would say the vast majority of individual cases we are confident now that one can achieve 80 percent removal without -- I would say without any substantial question of success; 90-95 percent removal only selected processes with achieve that, and even those, I think, we have a quite high reliability that we would succeed. On an individual case, I couldn't respond to.

MR. STEIN: Mr. Poole.

MR. POOLE: Well, I want to comment on this because I think we are getting down now to the nub of the whole thing as far as this meeting is concerned about Lake Erie. I don't have the benefit of the June Workshop Conference, unfortunately, although that is just a fault of my own shop not getting the memorandum around to me. But I am not convinced yet that on a year-round basis, we will say, that you can go much above 80 percent and stay within the realm of what I call economic feasibility.

Now, I have got some figures here that Mr. Miller, who is our sewage man, did give me, and he said that Pomona, California, got 82 percent reduction with lime at a cost of $45 a million. He says South Lake Tahoe got 86 percent reduction with chemical treatment, and then when they took the chemical treatment through a mixed media filter after that, it went up to 93. But he also says it cost $86/million gallons to do it. One of the Michigan plants got 84, and one at Grayling, he said, got 92 -- and you have already thrown up a flag of caution about this, and I think what little I know about it confirms what Larry and Dr. Stephan are saying that there is going to be quite a variation between individual plants. It seems to me that this has to be taken into consideration in any conclusion we come to as to what we are going to shoot for here in 1968 as far as Lake Erie is concerned, and it is going to take some argument to get me to go much above 80 as an annual average.

MR. STEIN: Well, do you have any comment on that?

DR. STEPHAN: Yes. I would like to point out -- I am sorry you weren't at the two two-day workshops we had in Chicago. I think they were quite enlightening.

The first workshop was handled by FWPCA Research and Development personnel reporting on our own experiences. The second conference, on the other hand, was a much more meaningful one in that it was a conference at which the various equipment manufacturers and design engineers and consultants involved in the business of actually doing this job, presented to the public at that point what they believed the technology was that they had in hand to remove phosphorus.

Again, as I indicated in my written answer, the responses at that workshop and the materials and topics covered were quite varied. There were some nine or ten different fundamental approaches toward phosphorus removal considered. I think perhaps only one of them that I recall claimed a percent removal less than 80, and I believe all of the rest were claiming and I think rather well assuring removals in the 80 percent and up level.

I would also point out that most of the costs were projected to a midwestern situation -- the Great Lakes situation were in the 5¢/thousand gallon range or much less. The Tahoe costs you quote are certainly correct. One of the reasons for this is the fact that their multi-media filters are aimed at accomplishing much more than phosphorus removal because they are accomplishing 98-99 percent removal of BOD at the same time. Other minor factors are simply the location of Lake Tahoe and the difficulty of bringing chemicals in.

MR. POOLE: Well, this five cents a thousand, or a quarter of a cent a day, or something, doesn't sound like much, but I want to ask Mr. Wirts back here what it is costing Cleveland for activated sludge plants now.

MR. WIRTS: About that same figure.

MR. POOLE: This is the point I want to get across.

We have got much smaller plants than Cleveland. We have our cities in the fifty to a hundred thousand bracket that are making contracts with suburban areas for

$100 a million, and they are making a little profit out of that. So we can say five cents a thousand, but actually what we are doing here is that we are upping the cost of sewage treatment from 50 percent to 100 percent depending on the size of the installation.

MR. STEIN: Just treatment not amortization?

MR. POOLE: No, this is debt service.

MR. STEIN: Debt service, too.

MR. POOLE: Yes.

DR. STEPHAN: Mr. Poole, one comment on that is this: The best cost data we can put together now on typical or average costs of conventional primary-secondary treatment in this country, let's say at a 10 million gallon per day scale, is around eleven cents per thousand gallons for a total plant.

The Easterly Plant here does not handle its own sludge and I suspect that is one of the factors. In addition, the efficient operation of John Wirts, of course, leads towards a unit cost which is somewhat less, and also it is a larger plant. But this, I would agree with you, sort of treatment would add something on the order of 50 percent to the cost of conventional treatment that is now practiced.

MR. EAGLE: This is my comment on Cleveland, and I believe we would like to get this in the record about the costs, and we do have to consider them, even though some people may not think they are very relevant.

But we are here in Cleveland, so let's talk about Cleveland a little bit: roughly 200 million gallons of sewerage a day, so we are talking in the neighborhood of $10 thousand a day additional cost, and this is about $4 million a year, or close to it. Then this would amortize probably $40 million worth of bonds -- something on this order. So we have already got a $211 million program in Cleveland, and you add $40 million onto it, and something has got to give somewhere, and something is going to have to be slowed down or shoved in the background if we are going to go into this program. This is a decision that we will have to give consideration.

MR. OEMING: Mr. Stein, I can't let go of Dr. Stephan quite this easily.

Dr. Stephan, you have placed quite a little confidence in the claims that were made at the Chicago conference. I think all of us in the business know how to put these claims into perspective, and that gets into perspective pretty fast when you are on the front line eyeball to eyeball with the person that says you have got to do this, and he is searching for that fellow that said, "Yes, I can do it," and that fellow isn't there then. He is there when you have a nice conference like this, but he is not there when you lay the job on the table and say, "All right, mister, now you said it, now you guarantee that you will remove it." And I think I would like to put that in the perspective, if you haven't already, that: don't place too much reliance on this -- and you are a research man, you know this is so. The proof is in the pudding, and all I say is that when you project this much beyond 80 percent with what you have given us to work with today, that you are stretching yourselves quite a little, and we have operating experience, I think, that we feel is pretty reliable.

DR. STEPHAN: I would like to point out, as I am sure you are aware, the technology of phosphate removal is very rapidly emerging. In 1965 we did not have any technology for phosphorus removal other than conventional systems, which I think at best would average around 30 percent removal of phosphorus. So, in the rather short period between 1965 and 1968, we have come to the place where I believe you have indicated that 80 percent removal is pretty well agreed upon can be obtained. The 90 to 95 percent, I admit, is on the margin. It is in the area where, I believe, we can attain it with one or two processes, not with a large arsenal of techniques. Eighty percent removal, I am convinced, we can achieve with a variety of processes, and of course I am familiar with the number of full-scale and pilot scale activities now underway where we are actually achieving this. I really have no doubt in my mind the 80 percent figures at that cost.

MR. STEIN: Dr. Stephan, I think we may be getting at the same kind of problem that we have had in various aspects of pollution control.

Now, again, possibly some of us who have different aspect of this business to look at share different views.

I know the notion of my going around the country and looking at plants that are rated at 90-92 percent, and seeing the days that they fall into the 70s, it gets rather dismal sometimes. But I think this is to be expected.

Now, you pointed out, one, that you are dealing with a chemical process and not a biological process. When the biological process goes sour, you just have to tinker with it until you write it up again and there isn't enough money in the world that can do it.

The difficulty that I find -- and maybe some of the manufacturers here, too, I am not talking in terms generally -- I have not found in the past if we were dealing in the chemical process, we were hitting the optimum mark too much better. The point is you can control the chemical process perhaps more than control the biological process. Only one rub: You are going to have some more chemicals and it is going to cost you money and these fellows operate on a budget and the guy -- and this works both ways -- as you know, with the biological and chemical process, you put the biological process to work and it runs. A guy gets a tight budget on running a plant on a chemical process and the first thing you save is a little bit of the chemical you pump in, and if you fail to meet your budget that week the chemical doesn't get in.

I am talking here with administrators from five States and the Federal Government and the people that we have to deal with. So, I am not sure that we realistically can talk in terms of a minimum, say, of 92, at this stage, because they generally fall to the 80s. On the other hand, if you say a minimum of 80, wouldn't they have to have a plant that was capable of doing about between 90 and 95 to achieve that minimum of 80?

I am asking the question.

Do they have to hit that high a level?

DR. STEPHAN: Mr. Chairman, I don't think you would have to go that high; 90 to 95 is the peak removal to average 80 with some of these processes. Certainly with others you would. But you are quite correct, the average of 80 is obviously going to be attained by averaging out some days, some hours, where the removal is substantially less than 80 and some where it is substantially higher.

MR. STEIN: Now, let me ask one question here, because I think this is the crux of it, and I think Mr. Eagle and his group raised this.

With all of the figures, if we are talking about terms, say, of a 92 or a 95 percent removal, and the Conferees make that as their recommendation, would we be kidding ourselves and kidding the public or could we really attain it, given the state of operation of waste treatment plants in the country today and the midwest where we are dealing with the situation.

Is this realistic for us to say we are going to get 95 percent removal and expect to come out 365 days a year and find we are getting it?

DR. STEPHAN: I think the simple answer to that is no. I don't think it is realistic to consider the 95 percent removal you have suggested as an annually attainable average removal which could be assured at this date.

MR. POOLE: Of course, Dave, if we advance as much in the next five years as we have in the last three, it could be realistic, couldn't it?

DR. STEPHAN: Well, we certainly are hoping to improve the technology to where we can do that, but I think you will find that the rate of approaching the optimum is going to fall off as we approach the optimum. Where we have come from 30 percent attainable removal in 1965 to 80 percent attainable removal now, we are obviously not going to keep up at that rate of improvement over the next three years.

MR. STEIN: Are there any further comments or questions?

MR. RICHARDS: I think one other comment might be in order, and that is: If you say 80 percent removal and indicate that this is going to be satisfactory in time, this is what you are going to get. I think it would be better to say maximize the removal of --

MR. STEIN: Oh, yes. Some of you may know about this controversy that we are having with some of the southern States on temperature removal, and some of the people here -- the biologists, for example -- have talked in terms of five parts per million of dissolved oxygen.

The notion that some of these people have who have the operating programs in the south is: Give them their streams from time immemorial -- when the Indians came or were here -- you couldn't get five anyway, you would dip below five. Now, the argument that is made sometimes, if we have a minimum of four parts for oxygen -- per million of oxygen — in order to achieve that four parts, they are going to have to have five parts most of the time.

Now, there may be an approach made to set a minimum here, and then say to maximize that when you can. And I am just suggesting that because we have had to do that in other fields when we have had these variables. This may be a way that we will be able to handle this. I don't know.

Are there any other comments or questions?

If not, we have two more questions, and it is 1:00 o'clock. You have to leave at 4:00, don't you?

DR. STEPHAN: I have to be on a plane at 4:00.

MR. STEIN: We have got to go on.

Let's take 16, and then we will decide -- will you continue with Question 16, please?

MR. HALL: Question 16: Is data available from these places to show what the resultant effect has been in the receiving waters? Are these plants discharging to lakes or rivers?

DR. STEPHAN: Answer: For the sites at which full-scale phosphorus removal operation or demonstrations have been conducted, no data are available at this time to show the resultant effect on the quality of receiving waters other than to confirm the obvious: that less phosphorus is in the receiving water than would have been if treatment were not employed. To our knowledge, reliable data to demonstrate a reduction in the frequency or intensity of algal blooms as a direct result of the imposition of phosphorus removal treatment at these locations does not yet exist. The reasons are varied: for South Lake Tahoe, discharge is not to a natural water body but rather to a man-made reservoir constructed solely to hold the effluent prior to reuse; for Prince William County, Chicago (Hanover Park) and Kinzua Reservoir, the plants have only recently gone on-stream; for San Antonio and Baltimore, the low phosphate effluents are mixed with other, less well-treated effluents before discharge; for Pomona, Washington, C.H., Xenia, Grayling and Lake Odessa the demonstrations were of a short-term duration; while for Amarillo, Las Vegas and Lansdale the effluents are not discharged but rather are deliberately reused.

Nonetheless, there is substantial experimental evidence that removal of phosphorus will have a beneficial effect on water quality.

Questions and Answers

Shapiro and Riberio (JWPCF July 1965) studied the addition of secondary sewage effluent to river water. They concluded that the river water alone was capable of supporting small levels of algae but that the addition of plant effluent increased their growth in proportion to the addition.

Mr. Chairman, there are several pages of similar citations which I can go through and read.

MR. STEIN: They more or less confirm the first one, don't they?

DR. STEPHAN: Yes.

MR. STEIN: Thank you.

(The remaining part of the above-referred to answer follows:)

In selective addition of phosphorus and nitrogen they were able to show that both were needed to stimulate growth of green algae but that phosphorus alone could stimulate growth of blue-green algae. They were also able to show that the removal of phosphorus from the sewage effluent would control the growth of both green and blue-green algae to a degree commensurate with the degree of removal.

Neil (12th Purdue Industrial Waste Conference) studied unnatural fertilization of Sturgeon Lake in

Southern Ontario and concluded that phosphorus does seem to be the common denominator in most lakes that are regular bloom producers. He also felt that to assist in the control of blooms a large input of inflow low in nutrients would be necessary to offset the addition of recirculated nutrients from the sediments and the algae themselves.

Ohle, W. (1953, Vom Wasser Vol. 20) in his study of eutrophic lakes concluded that phosphates must be regarded as the initial factor in the development of eutrophic conditions.

Sawyer (JAWWA November 1965) has concluded from his studies and literature search that phosphorus removal from municipal wastes is the most practical means of controlling growth of nuisance blooms of algae. Sawyer (JWPCF May 1966) also concluded that waters having a nitrogen to phosphorus ratio of less than 15 to 1 (which is the case in Lake Erie) will have productivities that are phosphorus dependent. He also concluded that restrictions on phosphorus discharges can be shown to limit and alter the nature of plankton growth. Furthermore, he stated that although there are many factors such as depth, size, shape, and geographical location which determine the degree of eutrophication, in general the basic factor involved is the algae nutrient budget of the lake and that the biological productivity is related directly to the nutrients available. In conclusion he says that it is axiomatic that a major factor in the control of eutrophication depends on limiting the amount of nutrients entering a lake.

Oglesby and Edmondson (JWPCF Septmeber 1966) reported on the control of eutrophication in Lakes Washington and Green in Seattle. They found that phosphorus was the key element limiting the level of algal production in regions where most nuisance conditions exist. They proposed the removal of phosphorus at its source and the dilution of phosphorus in lakes by the controlled addition of water low in nutrients. This was done in these two lakes and as a point of interest the dilution water was added at about the same relative rate that Lake Huron water is added to Lake Erie. From their studies they concluded that algal growths could not be maintained by fertilization from the sediments alone and that algal production and water quality in the lakes improved dramatically even to the extent that eutrophication was reversed.

Missingham, G. A. (JAWWA February 1967) showed that domestic sewage supplies a high percentage of nitrogen and phosphorus and that a high degree of correlation exists between nuisance algal conditions and extent of sewage fertilization. He warns that if nutrients from sewage plant effluents are allowed access to the water resources, then one can envisage increased algal growth, large populations of zooplankton, a depletion of dissolved oxygen in the hypolimnion, and replacement of game fish with the less desirable varieties of fish. Recreational uses of water have been and will continue to be reduced due to algal problems, with attendant reduction in property values. (This is just what has happened in Lake Erie.) He further warns that the onset of overfertilization can be so insidious that it often passes unnoticed until it is too late. He was able to show that blue-green algae will grow in the presence of a plentiful supply of phosphorus and a deficiency of nitrogen and concluded that phosphorus is a key element in the fertilization of lakes.

A survey by an AWWA Task Force (JAWWA March 1967) revealed that the major problem resulting from nutrients was eutrophication or a stimulation of algal growths in lakes and that human wastes and built detergents normally are the greatest contributors of phosphorus, one of the essential nutrients. They concluded that domestic wastes and perhaps some industrial wastes appear to be the only sources in which the phosphate concentration is sufficiently high to make removal feasible. Domestic wastes are a large contributor of phosphorus so that removal from this source should help significantly in reducing the rate of eutrophication.

Fruh, E. Gus (JWPCF September 1967) states that an algal bloom occurs when the number of algae per ml exceed 500. He summarizes the results to date on Lake Monona, one of the Madison chain of lakes from which sewage effluents have been diverted. He states that qualitative data show a marked improvement following diversion and even though blooms still occur, the frequency and nuisance intensity has decreased. He philosophizes by saying that the reason for the preoccupation of the sanitary engineer with nitrogen and phosphorus does not lie in the underestimation of the cosmic importance of photosynthesis, but rather in the recognition that this process is for all practical purposes, beyond control. Little can be done to alter light or CO_2 supply. By contrast, nitrogen and phosphorus, which are important in plant growth, are subject to control and modification through diversion or tertiary treatment of sewage.

Gordon M. Fair in direct testimony before the Lake Michigan Diversion cases in 1963 verified that phosphorus and nitrogen are the key elements promoting eutrophication and that in order to arrest the growths of algae the supply of phosphorus and nitrogen should be cut off. He furthermore supported the work of Sawyer by stating the Sawyer's data support the conclusions that the levels of phosphorus and nitrogen should be reduced below certain concentrations in lakes in order to control nuisance blooms of algae. Sylvester (1961, Algae and Metropolitan Wastes) also reached similar conclusions from his studies of the Seattle lakes.

Missingham (1967) and Oglesby (1966) and Shapiro have shown why phosphorus is often singled out as the key to control of algal growth and eutrophication. They say that:

1. Its supply naturally is low in surface waters to the extent that nuisance conditions of algae would not ordinarily exist and where it can be found in waters in abundance it is usually added by man's activities and therefore relatively controllable. Nitrogen, on the other hand, generally is much more abundant in soils and water and under aerobic conditions is much more soluble.

2. Phosphorus is more easily controlled than nitrogen. Blue-green algae can fix nitrogen from the atmosphere.

3. The phosphorus requirement of nuisance algae (blue-greens) is high.

4. Phosphorus will stimulate algae fixation of nitrogen.

Inorganic fertilizer (10-6-4) was applied by Ball, R. C. (1948, Transactions American Fisheries Soc. Vol. 78) to two lakes in northern Michigan. Heavy growths of plankton and filamentous algae occurred and during the second winter after fertilizer application, all the fish died from lack of oxygen. Two nearby control lakes showed no appreciable algal growths or oxygen depletion and fish levels remained constant.

McIntire and Bond (1962 Transactions of the American Fisheries Soc. Vol. 91) investigated four newly excavated ponds before and after fertilization with nitrogen and phosphorus. After fertilization, chemical and physical conditions were altered considerably by the production of large quantities of planktonic and benthic organisms. They found that the growths increased with increasing applications of nitrogen and phosphorus. In ponds that received nitrogen but no phosphorus, production was low.

In a report titled, "Removal of Algal Nutrients from Domestic Wastewater," by Rand and Nemerow of Syracuse University (March 1965) for the New York State Department of Health, it was concluded that the "indications are quite clear that the removal of nutrients from wastewaters will often aid in solving eutrophication problems."

Other authors have shown the importance of phosphorus in the control of lake eutrophication. A few of these are:

Lawton, G. W. (1960, Algae and Metropolitan Wastes)

Oswald, W. J. (1960, Algae and Metropolitan Wastes)

Odum, E. P. (1960, Algae and Metropolitan Wastes)

Lackey, J. B. (Sewage Works Journal, 1945)

Benoit and Curry (1960, Algae and Metropolitan Wastes)

Hasler, A. D. (1947, Ecology Vol. 28)

Mackenthus, K. (Fertilization and Algae in Lake Sebasticook, Maine, January 1966)

Thomas, E. A. (Biological Problems in Water Pollution Third Seminar, 1962)

Voss, W. (Gas--Wasserfach, Vol. 104, 1963)

MR. STEIN: Are there any comments or questions? If not, we can possibly go on.

One question I would like to raise with this one -- you know you can always raise this question: You can take Question 16 -- the data are available to show what the resultant effect has been in receiving waters after we put up conventional treatment plants either in industries or municipalities, and I think we have a shocking area of non information. I think Ohio is to be commended on this, because any test of any plant we put up is going to have to be what happens in the receiving waters afterward and not that you just put a plant in and another big monument to water pollution control which may or may not be doing the job.

Are there any questions on 16?

If not, let's go to 17.

MR. HALL: Question 17: What data are available to show the effect of more effective dispersal devices at treatment plant outfalls?

DR. STEPHAN: The answer to this is delightfully short.

We are actually unaware of sites where devices have been used for more effective dispersal of algal nutrients contained in treated sewage. At best, however, it would seem that such devices would potentially contribute only to a reduction in local concentrations of nutrients and would not reduce in any way the nutrient load entering the water body in the discharge. As explained in the answer to Question 10, nutrient availability is a key factor in determining the size of an algae crop and nutrient availability is a function of load discharged.

MR. STEIN: Are there any comments or questions on that?

If not, thank you very much.

Now, does any of the Conferees or the technical people they have invited or their advisors have any comments or want to say anything while we have the experts here?

MR. EAGLE: Yes. I would like to thank Dr. Stephan and Dr. Bartsch and, of course, Harlow and others who have participated here for the work they have gone to, to answer these questions. I think by and large they did a very excellent job and we appreciate that.

Several of the members of my Advisory Committee came here today and, by the way, they are the gentlemen that are responsible for most of these questions. We have only had one meeting but, believe me, it was a very good meeting and we expect to have more to work out a solution or solutions to this problem.

Now, I would like to ask if any of these gentlemen have anything they would like to say or any comment or statement they would like to make?

Sharon Bresler is a member of our Ohio Water Pollution Control Board and has been a very active member of this committee, and Sharon -- at least I would like to have you stand up so they can see who you are and if you would like to say a few words --

MR. BRESLER: I don't care to make any comments at this late hour. I am sure everyone is very hungry and so am I, but there is one thing in my mind that I haven't quite had clarified here today.

I am very sorry that we didn't have the answers to these questions earlier so that we could have studied them and perhaps asked more intelligent questions than perhaps this one is, and I am still a little bit confused about the 80 percent and the 92 percent.

I heard at one point where we have this in our pocket but we didn't use it at another meeting and therefore we concentrated on discussing the 80 percent.

I heard the Conferee from Michigan indicate that they have definite plans to proceed on the basis of removal of 80 percent.

At another point I heard where if this is done, in order to reach our objective, all other contributors to the phosphate concentration in the lake will have to remove a hundred percent.

Now, somewhere along here, I am having a little difficulty in my mind --

MR. STEIN: Well, we can understand that. I think we can answer that very, very rapidly.

One, no one had anything in their pocket that was a secret. Some people made a computation -- some of the staff people made a computation at the last conference. I am sure you get that in the State. We get that in the Federal Government for the various reasons that we heard here today: 1) that 92 percent figure was not used largely because it was felt that the 80 percent figure was the attainable one, and 2) as we heard again here today, as an operating program -- and this is to give you something -- we could not reasonably impose a limitation of 92 percent and expect that to be achieved and there not to be a violation. The notion was that with the kind of approach that we are going to make, an 80 percent minimum with an attempt to maximize, this would give you a substantial reduction in phosphates showing significant results and be achievable.

Now, on the basis of what we have done here in the Lake Michigan Conference -- and you also have to recognize that we first had a conference on the Detroit River before we started the one on all of Lake Erie -- that Michigan has moved ahead with its program and has incorporated this 80 percent removal in its program.

The notion would be that if Michigan -- it is a hypothetical question -- if Michigan would keep on with that 80 percent and we would ask 92 percent for the whole lake reduction, all of the rest of the communities would have to put in about a hundred percent, and the answer to that is yes.

But this is just a hypothetical question. The Conferees, it seems to me, have to come to the judgment of whether they are going to: 1) ask for phosphate removal or control at all, or 2) if we are going to ask for a percentage amount, how much? We have agreed in the past conference that we were going to ask for phosphate removal.

Now, in Lake Michigan, we have asked for an 80 percent removal. The question here is whether you should come up with any figure at all or whether you should ask for 80 percent removal or a higher removal.

At the first conference, three of the States on Lake Erie -- Michigan, Indiana and Pennsylvania, as far as I remember the record -- indicated that an 80 percent minimum would be satisfactory to them. The Federal Conferee indicated that would be satisfactory to him. Ohio and New York had not had this resolved yet. As you can tell, there are various difficult technical points, and I think the issue is clear on the basis of this. What do you think Ohio would recommend and want for the program for the lake?

MR. BRESLER: Sir, if I may say this --

MR. STEIN: Let me again state, I think because Mr. Eagle points it out, money is a significant factor.

MR. BRESLER: Well, it was established I believe that the goal was that a reduction to .01 milligrams per liter as a goal that should be striven for. Is this correct? Did we say this?

MR. STEIN: At the conference --

MR. EAGLE: This report says so.

MR. BRESLER: I believe it was mentioned in the discussion.

All right, what we are saying is our objective has got to reach that goal, but to make some reduction in concentrations of phosphate --

MR. STEIN: No. Here is the way I understood this -- and maybe I am incorrect in it -- we have a time schedule set up for the installation of municipal and industrial waste treatment facilities about 1970. Unless we fold in the phosphate reduction plants now, it is going to be a lot more expensive and we are just not going to make that schedule. We have to do this.

Now, the question here is: Given the state of the art, whether you hold back the whole program and not have the phosphate reduction in there, or you have some measure of phosphate reduction, or we have a minimum that we can fold in now to go ahead and make these gains.

I think part of the judgment that several of the States had -- that you can meet this time schedule and fold the phosphate reduction features into the plans if you had an 80 percent reduction requirement. Now, that is not presumably going to get to the objective, but as they point out, the technology is improving very rapidly. Lake Erie is not improving in condition. Do we want to go ahead with this construction program without the phosphate removal features of the plans.

If we do want them in the plans, it seems to us we have to come to some kind of policy and set a guideline on what they should be. At least we should make a judgment one way or the other.

Now, these are the issues, and I also think that, again, in this Federal-State-relation operation we almost have to go in together if we are going to make it.

MR. BRESLER: Thank you, sir.

No further comments.

MR. EAGLE: Anybody else?

Thank you, gentlemen.

MR. STEIN: Are there any other --

MR. BOARDMAN: To put Pennsylvania in the record, we are here today. Unfortunately, we didn't through some mixup probably in our own mail room, receive a copy of the answers to the questions, so I was in the same position that many of you were in that I didn't have a set of the answers in front of me. But our staff had looked at the questions and their answers were quite similar, but maybe not as eloquently put as those that were published today.

We, like Mr. Eagle, I think have the same goal--that we would like to solve the pollution problems of Lake Erie. We feel that probably 80 percent phosphate removal is much better than 20 or 30 percent removal and maybe isn't ideal, but we would like to see the Conferees come to agreement rather rapidly on some minimum requirement so that we can get on with the job of at least starting to take a crack at the problem in Lake Erie. So we hope that this meeting will be the next step toward a rapid resolution of this problem so that we can get moving on Lake Erie.

No further comments.

MR. STEIN: Are there any other comments?

Mr. Poole.

MR. POOLE: Well, first, I want to commend Dr. Stephan and Bartsch and Mr. Harlow for putting this together and sending it around. I got mine Friday afternoon, and I think it has certainly expedited this meeting here today, and you have done a top-flight job as far as I am concerned.

I want a little clarification of some of your remarks, Mr. Chairman.

You referred repeatedly to 80 percent minimum, and I have referred to 80 percent as far as Indiana is concerned. But I am talking about an annual average of 80 percent. I want to be sure you are not talking about a minimum today of 80 percent, because we get to operating treatment plants and there is a lot of difference And we are prepared to subscribe to an 80 percent annual average with the understanding -- particularly with bigger installations -- that they be admonished when they go into this, that if the art develops and their experience expands, if they can do it better than 80 percent we are going to expect them to do it. That is presuming that the costs are reasonable. The time schedule of 1970 -- that shocks me a little. I wasn't aware that we had ever had any discussion of 1970 for phosphate removal around the Lake Erie Basin. To be perfectly candid with you, if Uncle Sam doesn't get his money up where his mouth has been for the last four or five years, we are not going to meet any 1970 objective in Indiana, because these knuckle-headed Hoosiers are very strongly resisting spending their money when they think they can wait another year and maybe the promises that were made in the Water Quality Act will come through and they will get a grant. So I can't bind Indiana to any firm date of 1970. I think I could for 1972, for all of the major installations, and I have only one other comment.

We are concerned right now with the little town of Huntertown, which is up the river from Fort Wayne, that has a 660 grant and a State grant to build its first sewage treatment plant. I think it has about 700 population. The plant is all designed. We wrote them back the other day and said, "What about phosphate removal?" Candidly, I hate very much to force Huntertown, Indiana, into being the first phosphate removal installation in the State. I think we are going to play footsie with you on these little installations for maybe something longer than even 1972, because I do believe that there is an element of realism that has to be worked in this program.

MR. STEIN: I think that most of the positions you have stated, I could be persuaded -- possibly the Federal conferee can. I don't think we are going to be far off. There is one point of clarification, and this is the one I made. With the dates we've set, we set those dates as you recall for the conventional treatment plant, it would be a tremendous savings in money for the design and the operation if we could come up with a unified program and begin folding those in now.

MR. POOLE: I agree with you completely. We are asking all of our municipalities on both the Lake Erie and Lake Michigan watershed if they are making plans now either for plant expansion or for new installations, to include phosphate removal.

MR. STEIN: And you know, I guess, we have gone through this socio-routine many, many times. But when you talk about those knuckleheads in Indiana -- and I can sympathize with them -- about Uncle Sam putting his money where his mouth is, I don't know who puts up their money but the representatives in the Congress of the five States represented here -- and including my State of Virginia and any other State -- and I don't know who is skinning whom, because wherever that money comes from, it is our money.

We pay for it one way or the other, but I understand the position.

What I think is abundantly clear, and I will make this very clear: One of the major cities in Indiana, which is the best example of this we had, acknowledged if we wait and we don't get this program going, for every year we wait it is going to cost a lot of money.

Mr. Poole got an order against one of his major cities in Indiana, and they took him to court and fought that for years. By the time they got around to building that plant I think it cost them three times as much as it would have cost them originally, and this is the point I am making. Gentlemen, make this abundantly clear. We have a multimillion dollar program ready to go on Lake Erie. There is one item that may be holding this up, and this is the agreement and the policy on phosphate removal.

The sooner we get that resolved -- every day sooner you get that resolved is going to mean a savings of a considerable amount of money to get these things going right now and not wait and fight this rising cost.

Are there any other comments or questions?

If not, now, we have several things we are going to take up, and I don't think we have to keep everyone here. One is the surveillance that Mr. Eagle talked about.

I think we will have to work that program out. The other is some of the problems you mentioned to the Technical Committee which we revised, and hopefully we would like to canvass the State Representatives here to get the Conferees together as soon as we can in perhaps just a short session without anyone except the Conferees participating, although under the law, of course, you can bring anyone you wish to participate to try to resolve, if we can, this phosphate issue and get on with the program.

If there are no further comments --

MR. POSTON: Do you intend to do this today?

MR. STEIN: No. We are going to adjourn sine die pretty soon. If you have anything to say, say it.

MR. POSTON: Well, I would say that it appears to me that we have been changing in this whole field of waste treatment requirements from primary to secondary and we are even talking about tertiary now, and this has been over a realtively short period of time.

I think that at the time Detroit was involved, the Enforcement Conference, at the request of then Governor Swainson of Michigan, came up with certain recommendations about phosphate removal, and then Governor Rhodes called a conference about Lake Erie problems because of his great concern not only locally but

State-wide and internationally. He thought there was concern, and this is the reason that he asked that a Federal enforcement action be called.

I think I personally felt that we had gone a long ways towards getting an action program going when Michigan implemented certain suggestions and came forth with an 80-percent-removal figure for phosphates from Detroit, Michigan's waste discharge to the river in that area, and when the Lake Erie action called for maximization of the phosphate removal, I felt that until you get a number that you can shoot for, maximization can mean a lot of different things.

I think our technical people assure us -- and they have done that again here today -- that 80 percent is well within our grasp. I think my concern is Lake Erie, to do something for the situation that exists there, and I think the sooner we get on with this, the better it is going to be for Lake Erie and for our use of Lake Erie in the future.

I won't promise that we might not have greater restrictions in the future because that is the way the whole picture looks, from primary -- we didn't think of secondary for a lot of plants in the past and now we are talking tertiary, so I think it is pretty plain to me at least that we ought to move along with the program that we have in our grasp here.

MR. EAGLE: Wally forced me to speak again -- I can't let this go by -- that just because this group doesn't set a figure here that nothing is being done in phosphate removal. A lot is being done in phosphate removal. We have three plants right here on Lake Erie that are going to be constructed very shortly. I think some of them are almost ready to submit contracts that embody phosphate removal, and many more are on the drawing boards that embody phosphate removal. So a lot is being done on phosphate removal here in Ohio and the program is moving forward. This is not to say we should not have some agreement here. I don't mean that. On the other hand, I don't want the general conception here that nothing is being done in phosphate removal at this time, because an awful lot is being done.

MR. STEIN: Do any of the Conferees have anything to say?

I want to thank you all for coming. I know I felt this was a very productive meeting. The fellows did a magnificent job. They made a very good seminar. Thank you all for staying with us. We hate to go this late, and when we run a meeting this late -- you know, as the

Governor of North Carolina said to the Governor of South Carolina, "It is a long time between drinks!"

(Whereupon, at 1:33 p.m. the conference was adjourned sine die.)

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